Haptic Automated Communication System (HACS)

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PROBLEM STATEMENT

Current communication capabilities between dismounted warfighters, as well as up and down the chain of command, are limited, directly impacting situational awareness (SA) and tactical decision-making. Radio communications between unit members are transmitted and received on a single channel, thus creating a communication challenge as only one unit member can transmit information at a time. Furthermore, few dismounted warfighters within a unit have radios. This creates a situation in which transmitted information must be prioritized with only the most important information transmitted rather than communication being comprised of all unit information. Blue Force tracking systems currently present information via visual display, and only location information is provided. Body posture, movement, and weapon status information could be used to identify commands being carried out, engagements with enemy forces (including direction of enemy, severity of enemy engagements), and ammunition depletion. The location of enemy forces, identification of casualties, and mission progress can be more accurately derived from this information than is capable in today's environment. Automated data collection and communication enables unit commanders to obtain this information from multiple teams and team members simultaneously, facilitating coordinated efforts.

Additional status information and commands must also be communicated between individual team members in order to maintain team situational

awareness and conduct team operations. Hand and arm signals are the primary communication method between infantry Marines while conducting combat maneuvers. Infantry Marines often utilize an established set of hand signals in order to communicate with others while maintaining noise discipline. These commands propagate from one team member to the next ensuring that team members not in line of sight of the initial team member receive the transmitted information. While this current process is effective, it can be time consuming.

Embedded recognition and communication of hand signals to all team members would enable entire teams to receive orders and information simultaneously regardless of line of sight limitations. Postural, movement and haptic-based communication and automated data collection enables unit commanders to obtain information from multiple teams and team members simultaneously, facilitating coordinated efforts. The location of enemy forces, identification of casualties, and mission progress can be more accurately derived from this information than is capable in today's environment.

This product addresses the need for alternative communication methods for use in operational scenarios in which visual and/or verbal communication is not possible or desirable, as well as the need for instantaneous and simultaneous communication of relevant information to multiple team members, as well as up and down the chain of command. HACS also addresses the need for unobtrusive and intuitive means for communicating with team members and for controlling unmanned assets.

WHO CAN BENEFIT?

The HACS technology will directly benefit teams of dismounted warfighters, as well as commanding officers making tactical decisions, and is appropriate for acquisition by the Marine Corps, Army, or Navy customers. This technology is also ideally suited for special operations teams, as well as teams conducting operations involving unmanned ground vehicles. In addition to the providing enhanced SA and communication capabilities between warfighters, the HACS technology provides an ideal interface for seamless command and control of unmanned vehicles.

Additionally, Federal, State and local law enforcement teams, as well as first responders such as fire fighters and emergency rescue personal would benefit from this team communication and situational awareness technology. Law enforcement and first responders face many of the same team situational awareness problems that counter terrorists operators face such as extremely dynamic and hazardous environments and

situations with limited personnel resources. Additional applications for components of the HACS system include the gaming industry and robotic control applications.

BASELINE TECHNOLOGY

Current communication and team status monitoring technologies include short-range radios and blue force tracking systems. Radios, even when used with throat microphones and bone conducting phones require speech, which may violate noise discipline during stealth operations. Additionally, such radios are operated on a single channel, reducing the amount of information that can be communicated at any given time. Currently no technologies exist for electronic recognition and communication of hand-and-arm signals. Blue force tracking systems currently present information via visual display, and only location information is provided. Body posture, movement, and weapon status information could be used to identify commands being carried out, engagements with enemy forces (including direction of enemy, severity of enemy engagements), and ammunition depletion. The location of enemy forces, identification of casualties, and mission progress can be more accurately derived from this information than is capable in today's environment.

TECHNOLOGY DESCRIPTION

The Haptic Automated Communication System (HACS) consists of a Team Status and Signaling System (TS3) and a haptic feedback vest. The TS3 consists of a dead reckoning module that contains accelerometer, digital compass, and global positioning system (GPS) sensors, as well as an instrumented glove (iGlove) with embedded accelerometer, digital compass, and gyroscope sensors. The dead reckoning module provides real-time capture of individual location and activity (i.e., walking, running, standing, kneeling, prone) information, while the iGlove provides real-time capture of hand-and-arm signal information and weapon-firing status. Pattern matching and gesture recognition software running on a ruggedized wearable computer interprets the sensor information from both the dead reckoning module and the iGlove, including recognition of standard military hand-and-arm signals as well as custom static and dynamic gestures. Relevant information is communicated wirelessly to the ruggedized wearable computing systems worn by other team members, as well as up to higher headquarters when appropriate. Incoming messages are displayed via actuation of the vibrotactile feedback vest and may be displayed by additional means as well.

Under a complimentary ONR-funded Phase II SBIR effort, Design Interactive, Inc. (DI) is developing a haptic language, which includes intuitive display patterns for the standard communication messages, as well as a means for creating custom haptic symbols.

	Feature	Advantage	Benefit
Instrumented Glove (iGlove)	Embedded accelerometer, gyroscope, and digital compass sensors capture static and dynamic hand signals and weapon firing status information	Hand signals and weapon firing status can be automatically captured electronically without additional field equipment	Relevant hand signal and weapon firing information can be communicated to multiple team members instantaneously and simultaneously via multiple modalities
Dead Reckoning Module	Embedded accelerometers, gyroscopes, digital compass, and GPS sensors capture team member location and activity information	Team member location and activity information can be automatically captured electronically	Relevant team member location and activity information can be communicated to multiple team members instantaneously and simultaneously via multiple modalities
Ruggedized Wearable Computing Device	Deployable computing device with pattern recognition software and wireless communication capabilities	Team hand signal, location, and activity information can be processed and communicated in a field environment	Enables dismounted warfighters to communicate with each other via alternative modalities in a field environment
Vibrotactile Feedback Display Vest	Vibrotactile motors embedded within current field gear can be activated to convey information via the haptic modality	Communication via the haptic modality enables information to be conveyed discreetly with hands, eyes, and ears free	Enables dismounted warfighters to receive relevant information without compromising security or situation awareness

CURRENT STATE OF DEVELOPMENT

The individual components of both the TS3 and STRAP devices have been developed and integrated into a functioning HACS prototype. Current efforts include enhancement of the individual components, including ruggedization, integration with current field gear and communications infrastructure, and enhanced user interfaces. The current TRL is a 4. Under the Phase II option tasks, the technology will mature to a TRL 5,

and the completion of a series of field tests with end users in Thailand during July and August, 2010

REFERENCES

AnthroTronix, Inc. (ATinc) received letters of support for the HAC S Phase II effort from potential industry partners (Lockheed Martin Advanced Technology Laboratories) as well as potential end users (Active Duty Marine Corps platoon leader). ATinc has worked with Lockheed Martin to leverage complimentary technologies, including the Distributed Operations (DisOPS) field communication and tracking system and to incorporate components of the HACS technology into existing prototypes and products. ATinc is also working closely with potential end users to identify strengths and weaknesses of the current technology; the HACS technology has been selected to be included in the United States Pacific Command (USPACOM) Crimson Viper and Cooperation Afloat Readiness and Training (CARAT) field tests in Thailand in July and August of 2010, which will include a variety of potential end users such as special forces teams.

ABOUT THE COMPANY

AnthroTronix, Inc. (ATinc) is a human factors research and development engineering firm specializing in advanced human interface devices for use in extreme environments. Technologies developed by ATinc include advanced, multi-modal input and feedback devices that exploit the visual, auditory, haptic, and olfactory modalities (e.g., instrumented gloves; wearable and weapon-mounted robotic control devices; and haptic feedback displays). ATinc has considerable experience in designing haptic devices specifically for military applications: past efforts have included the development of vibrotactile vest, belt, and armband displays for unmanned vehicle control and team communication.