Smart America Challenge

Smart Emergency Response Saves Lives

Goal: Provide a Smart Emergency Response System (SERS) that connects cyber-physical technologies with humans in the loop to save lives, rescue people, and attend to their critical needs when disaster strikes.

The system includes human first responders, heterogeneous ground and aerial autonomous vehicles, human-operated tele-robots, and trained search and rescue dogs. It is aided with real-time sensors, help request apps, optimized resource deployment, real-time visualization, and robust communication using diverse network types.

Field of Study	Smart Emergency Response System Feature	Societal Impact
Shared autonomy	Augmenting first-responder capabilities	Improving availability and quality of emergency response
Operations	Integrating field resources into a coherent mission	Empowering citizens
Networks	Providing an adaptive, robust, and broadband wireless response network	Connecting people anytime and anywhere
Optimization	Minimizing delivery time for life- essential supplies	Saving lives and providing quicker medical assistance
Robotics	Enabling tele-operated and autonomous robots, biobots, and humanoids	Using machines for dangerous and challenging tasks
Co-robotics	Enhancing mixed-initiative collaboration among machines and between humans and machines	Serving a population's needs more quickly and more comprehensively
System integration	Integrating humans and various levels of machines in one mission	Leveraging engineering disciplines to solve societal challenges
Education/training	Participating in simulated emergency response scenarios	Preparing highly qualified personnel and workforce

Mission Command and Control Center

Real-time mission command and control:

- Field, prioritize, and handle requests
- Optimize resources in a timely manner
- Dynamically provision and allocate assets
- Remotely control vehicle fleet dynamics
- Receive, organize, and display sensing and status information from assets
- Perform real-time visualization in Google Earth

Networks

Adaptive network-to-network mechanism:

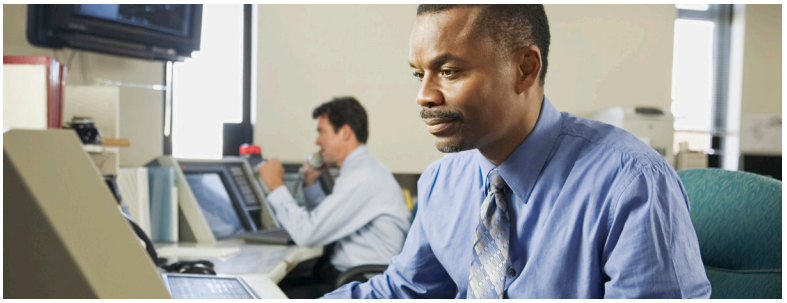
- Broadband WiFi networks via commodity drones with directional antennas (5km)
- Ad-hoc wireless networks for cellphones
- Adaptive relay networks to command and control center (10m)
- Secure, robust, dynamic, and physically private network

Field Operations

Autonomous and semi-autonomous vehicles, humanoids, robots, and biobots with:

- Real-time sensing
- Tele-operation using haptic control
- Video and audio communication link
- Dynamic provision for specific needs of emergency scenario
- Registration of citizen sourcing
- Automatic update of survivors' social media

Project realized for SmartAmerica Challenge, www.smartamerica.org, 2013–2014.



Technological Breakthrough: The confluence of cyber-physical technologies, data-driven predictions, and human-in-the-loop telerobotics drives innovations in the Smart Emergency Response System.

Features

Technology

- Remote two-way communication between human, robotic, and canine field assets and mission command and control center
- Ad-hoc wireless communications between people's cellphones without relying on cellular networks
- Opportunistic, wireless, secure, and robust communications using a network of commodity drones with WiFi technologies
- Real-time video and audio streaming from field assets
- Modular sensing technologies to make provision "plug and play" for various emergency missions
- High-performance mission command and control center
- Dynamic optimization of time and resources
- Predictive estimation of mission progress using simulation
- Autonomous collaborative fleet of vehicles
- Various types of lifting robots, humanoids, and biobots
- Full automation of select stages in the deployment process
- Enhancement of relief operations
- Extendable system architecture

Human in the Loop

- People's smartphones serving as ad-hoc network relay nodes
- Smartphone apps for people to report and request help
- Tele-operation of field robots using haptic control to give an operator the sense of touch
- Real-time update apps for people to understand the emergency response devices operations around them
- Engaging mechanisms for citizens to register their devices in the mission

Impact

Saving Lives

- Minimum emergency response time
- Real-time update and automated emergency response
- Reduced risk during disaster scenarios
- Optimized city response units and medical infrastructure

Job Creation

- Telerobotic operators (as an opportunity for returning veterans)
- Usability experts
- Human-machine interface experts
- Device app designers and developers
- Public service experts and entrepreneurial citizen scientists
- Unmanned aerial vehicle pilots

New Businesses

- Device-based services and apps
- Automated pickup and delivery service
- Remote, continuous, and automated inspection and surveillance
- Private, opportunistic, physical network service
- Supply chain optimization

Economic Growth

- Human productivity growth
- Ecological footprint reduction
- New pricing models for transportation and delivery services
- Decrease in maintenance and operation expenses
- Service time reduction

Vision: Empowering and augmenting humans with actionable artificial intelligence and smart devices to raise society's level of prosperity and prepare a workforce qualified to operate and exploit technologies of today and tomorrow.

SERS
Smart Emergency Response System

BluHaptics | Boeing | MathWorks | MIT Media Lab | National Instruments
North Carolina State University | University of North Texas | University of Washington
Worcester Polytechnic Institute

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