

Project Summary

This project addresses homeland security, an issue of highest national priority, with a goal of monitoring, preventing, and recovering from natural and inflicted disasters. In particular, we propose to create a novel technology-enabled security framework, called **Pervasively Secure Infrastructures (PSI)**, that will make use of such advanced technologies as smart sensors, wireless networks, mobile agents, data mining, and profile-based learning in an integrated, collaborative and distributed manner. The proposed PSI framework consists of a lower-end tier, composed of basic data collected from sensor networks and other resources, and a higher-end tier that fuses (or combines) data collected at the lower-end tier to make intelligent decisions and provide security services.

Through an existing NSF supported project, we are developing the concept of *community computing* as a framework for the development of pervasive computing applications. In community computing, goal-oriented software agents working on behalf of lower-end sensors and devices, collaborate with each other to carry out application-specific services. In trying to apply the community computing framework to provide pervasively secure infrastructures, many significant and challenging problems lay ahead, including: (i) data collection and aggregation from heterogeneous, seemingly unrelated sensors; (ii) real-time, secured, authenticated information processing and exchange; and (iii) discovery of security threats using data mining, learning and intelligent decision making techniques. In order to address these problems we have formed synergistic teams of investigators from three universities with extensive experience and background in areas directly relevant to the above challenges. Our project management plan utilizes meaningful collaboration among our research teams to ensure successful fruition of the project.

Intellectual Merit: The uniqueness of this proposal lies in the synergistic combination of the proposed research in sensor network data collection, real-time information processing and exchange, and intelligent situation awareness (e.g., threat detection). Our innovative research in sensor network data collection includes efficient *aggregation* and *harnessing* of collected information from heterogeneous sensors/monitors. Real-time information processing (including audio/video and text) is addressed through novel techniques based on *secure transmission*, *authentication* and information *sharing* using a multi-database thesaurus approach. Intelligent situation awareness is achieved through new *learning*, *data mining*, and *knowledge discovery* techniques. The synergistic combination of these research efforts will be accomplished under the framework of our existing community computing paradigm. Additionally, we plan to demonstrate the validity of our proposed approach through the development of a prototype of the PSI applied to airport security as a target application.

Broader Impact: The PSI framework can potentially be deployed in a variety of safety, security and surveillance instances, including transportation (e.g., air, rail, highway), public utilities (e.g., water, gas, electricity, nuclear power station, Internet), public or private buildings and gathering places (e.g., airports, train stations, commercial buildings, shopping malls, and amusement parks). The project will involve new research initiatives in sensor networks, data fusion and mining, profile-based learning and prediction, network security, pervasive computing, dynamic creation of software agent communities, location and context-aware computing, and real-time communication and computation. This project will train PhD, MS, and BS students at all three universities in these critical areas of national interest, leading to excellent theses and high quality journal and conference publications. This project will further strengthen the already existing collaboration among various PIs at the three universities. Several PIs have a proven track record of mentoring and graduating minority and women students. This trend will be continued with more aggressive recruitment from under-represented groups. Research findings will be integrated into existing courses (e.g., networking) or newly proposed ones like pervasive computing and security. This effort will be coordinated and shared by the collaborating universities through Web based distance learning courses that will also be used for wide dissemination of research and prototyping results.