Demo Abstract: Dynamically Configurable Robotic Sensor Networks

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1. INTRODUCTION
In-situ reconfiguration is indispensable in sensor network deployments. It is required for efficient software management in large-scale sensor networks, re-tasking a deployed network, or for recovery after attack. We have built a system that supports multiple levels of reconfiguration. It consists of Dynamic Application Specific Virtual Machine (DASVM) running on the SOS operating system. This is demonstrated on Ragobot, which is a power efficient and scriptable platform for swarm robotic sensors.

2. DYNAMIC ASVM
Dynamic ASVM (DASVM) is a domain-specific interpreter for the SOS operating system. It enables limited high-level functionality alterations by injecting concise application-level scripts, thereby providing very efficient network programming and reconfiguration. DASVM is an enhancement of the TinyOS ASVM (Maté). With Maté, any modifications to the ASVM core require fall back onto the TinyOS/Deluge mechanism, which updates the entire ASVM binary. In contrast, DASVM is composed of modules (scheduler and libraries) that can be individually updated using SOS. The byte-code instructions supported by the DASVM are implemented by loadable library modules. Every DASVM supports a core set of instructions that are implemented in a BasicLib. The scheduler module is always loaded with the BasicLib. Instruction set extensions to the DASVM can be made through the addition of other library modules. Our main Ragobot library, RagoLib, enables the user to control Ragobot remotely using simple scripts. Another ASVM characteristic is that we use user-configurable Interrupt Service Scripts that control Ragobot’s response to many different events, e.g., when an obstacle or a cliff is detected, or when a packet is received, etc.

3. RAGOBOT
Ragobot (see figure) is a very powerful, compact mobile sensor node. It measures only 60.0mm wide and 133.5mm long. The instrumentation suite includes video/audio capture and playback, IR collision/fall avoidance, RFID read/write, and inertial navigation, among other things. Ragobot is capable of over a 35 degree vertical climb over uneven terrain and its tiered-module architecture provides tighter integration/energy-efficiency than a unified backplane scheme.

4. DEMO DESCRIPTION
We demonstrate the real-time network-wide reprogramming of mobile nodes using an actual mobile network of Ragobots. The Ragobots will be loaded with DASVM and controlled wirelessly by multiple user consoles, each with a GUI that enables easy scripting. Different libraries will be loaded at run-time depending on the application requirements, enabling network reconfiguration at multiple levels. The Ragobots will be moving in Ragoworld (a miniature terrain that is replete with hills, canyons, steppes, rivers, and other natural phenomena) and will be able to align and dock with RagoDOCS (a dynamically configured recharging station) as shown in the figure above.