On-Demand Adaptive Computing With Mobile Devices

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Introduction

On-demand adaptive computing stands on the principles that machines or devices might not always have every resource available to complete a desired task, and that for unexpected events or scenarios, it may not be known what devices and capabilities are available in the field and thus cannot deploy applications in mobile devices in advance. Therefore, instead of limiting the tasks that could be completed to the capabilities of a single device, a general framework would allow for different devices to be programmed according to their capabilities.

Objective: This research was conducted to:
- Create a general framework for on-demand computing that will automatically generate a program based on a device's capabilities without need for direct human input.

Potential Applications:
- eHealth
- Military applications
- Environmental disasters

Example:
In natural disasters situations, mobile devices can collectively perform search and rescue operations. One major challenge for these systems is to harness the available resources (e.g., other robots, sensors, cell phones, cameras, etc.) in the surrounding environment to accomplish their assigned tasks. This necessitates that the mobile devices be aware of other nearby devices, and know their capabilities and how to utilize them. To that end, this project develops an on-demand computing platform in which certain tasks are achieved by partitioning applications into portions and deploying those portions on various devices based on their capabilities.

Implementation

Experimental Setup:
- Dell Inspiron
- MicaZ motes
- iRobot Create

1. iRobot Create searches area for MicaZ motes using Java listening program
2. Once within range of a mote the home-base parses the data received and determines the current version of software and ID on the mote.
3. Based on version and ID an application is assigned.

Framework

On-demand computing depends upon the ability to split up a task into several pieces that can be distributed to other systems to be completed. Our framework enables one device to generate specific programs that is then distributed to another device, such as a sensor. This framework is built on modules and templates. Templates provide the most basic functionality such as ability to boot on the sensor. They are able to compile themselves with no modules added. Modules provide more advanced functionality such as finding an average of a dataset or sending a packet over radio waves. Modules are plugged into a template to create a finished application.

Results

- The robot can keep track of distances traveled and degrees turned, to be later used to record areas covered.
- The robot can search for and find a mote. It then disseminates code to the mote with the assumption that the mote's capabilities are already known to the robot (i.e. the robot has a database of the IDs and disseminates a predetermined application).
- Netbook can queue motes if many are in the vicinity by checking queued motes. It then uses a version number to determine if the mote has already been reprogrammed, if not it will queue the mote.
- The framework creates modules by taking a template file and filling in xml tags with the information provided in the module list. Then it creates a working application to be disseminated to the mote.

Further Work

Further Work:
- This framework expects the modules to be handed to the application builder in the correct order. If they are out of order, then it is unlikely that the finished application will compile for the mote.

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