Project Proposal
Automated configuration and IP discovery for Raspberry Pi

Sponsor
Dr. Phil Romig, Department of Computer Science

BACKGROUND

CSCI 250 uses a Raspberry Pi (Pi) to provide students from all majors a hands-on introduction to programing for hardware and sensor systems. The Pi, a full featured desktop computer complete with a quad-core CPU and 2GB of RAM for less than $50, is an ideal platform for this application. To maximize time in the lab the Pis are used "headless": connecting to them over the network rather than cabling them to a monitor, keyboard and mouse. This headless approach presents two major challenges. First, the computer must be configured for network access before it can be used and second, each time it reboots it requires a mechanism to discover the IP address assigned by the network. The current solution is to connect a keyboard/video/mouse for configuration and to have a script that sends an email with the IP address each time the system connects to a network.

Both solutions have become problematic. The need for a monitor to perform initial configuration restricts the labs in which the course can be taught to those with monitors equipped with HDMI input. Currently only Marquez 022 has the required hardware. Tightening security by many ISPs limits where the computer can send email so much that the current solution only works on campus

WORK TO BE PERFORMED

A team taking on this project will be asked to develop solutions to both problems.

The Raspberry Pi uses a micro-SD card in place of a hard drives. This allows us to address the configuration issue by mounting the SD card on a Windows 10 desktop and developing a script that makes the appropriate modifications to the Pi's configuration files (made up of simple flat-text files).

To solve the IP address discovery problem the team will be asked to install and configure a web server on an existing Linux workstation and then develop and implement a protocol that allows the Pi to use HTTPS to communicate its current IP address to the web server. The team will also be asked to deliver a front-end interface for the web server allowing students to see the IP address of their device. Teams will have the freedom to propose any solution that meets these basic parameters. However, the delivered solution must include appropriate authentication for both the communication from the Pi and for the user accessing the stored information. Acceptable mechanisms for authenticating the Pi include a unique, signed, shared secret

or authentication at the HTTLS layer using client certificates. The preferred method to authenticate users is the school's centralized authentication system called Shibboleth.

DESIRED SKILLS

A team interested in taking on this project should have a basic knowledge of the Linux operating system and at least one common scripting language (Perl or Python are preferred). Team members will need to develop an understanding of Linux file system layout, the configuration language used by the PiOS (a version of Linux), web programing, HTTP, Transport Layer Security, and the Simple Authentication Markup Language. While teams are expected to be able to work independently the sponsor is familiar with all the information needed and will be available to provide guidance at any time.

WORK ENVIORMENT

This project is ideal for a smaller team of three students. Team members may work on campus or at home, whichever they prefer. Testing must be done using the campus network, requiring at least one student to be able to come to campus. Each team member will be loaned a Raspberry Pi to work with for the duration of the project. Each member will need a second computer to use as an access device. If team members don't have access to a computer, they may use a computer in the campus computer labs.

While there is no opportunity for an internship after the completion of the project the sponsor is unusually fond of doughnuts and it is very likely that there will be some in his office from time to time.