Remote Lab Station

BCE 496: Capstone Design 2

External Specification

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# Introduction

The University of Washington Bothell campus is a commuter campus meaning many students commute over a distance (sometimes long) to attend classes. The Remote Lab Station allows students to work on lab experiments at any time and from anywhere.

Using remote desktop applications, a student or faculty member is able to gain access to the Remote Lab Station and run experiments on the plugged in daughter boards. Daughter boards are lab experiments designed by other capstone groups that may give the ability to change node voltages, resistor values, and capacitor values in a circuit.

A user may connect remotely to the Remote Lab System. Upon connecting to the system, they have access to the the hardware on the computer where the Remote lab system is set up. They will have access to the Velleman Oscilloscope and Function Generator and will be able to run tests on real hardware in real time from the comfort of their own home. They will even be able to change values for the tests they are running to make sure they have everything they need to complete their lab.

Due to new restrictions from the UW-IT department, a VPN token (Husky OnNet) is required to connect to the UW campus network remotely. Refer to the [UW IT Husky OnNet About Page](https://itconnect.uw.edu/connect/uw-networks/about-husky-onnet/) for more information.

# User Guide

The Remote Lab System Graphical User Interface (GUI) and Arduino software was tested on Windows 7 and Windows 10. We do not guarantee the software’s function on any platform.

In order to connect to use the Remote Lab System the user must connect to the correct campus workstation with the system plugged in. The student should obtain or be provided the workstation’s IP address by a leading faculty member.

Once there, an executable file named “RLS.exe” can be opened and experimentation may begin. To open the Oscilloscope and Function generator software, simply press the “Oscilloscope/Function Generator” button. To open one or both of the LogicPort software, press one of the corresponding “Logic Analyzer” buttons.

Before changing any of the settings in the GUI, a “Check Board” operation must be completed by pressing the “Check Board” button.

The “Update Board” button will again first verify the same board is still installed before sending the desired settings. If the same board is not installed, the user will be warned and updating will not be allowed. Otherwise, after verification, the updated settings will be transmitted to the Arduino.

# Hardware Specifications

* Chassis
  + Size - 10 in x 10 in x 6 in
  + Material - Galvanized Steel
  + Weight - 9lbs
* 2x rear connectors
  + One USB connector
  + One DIN5 power connector
* 1x 80mm Fan
* 4x 40 pin connectors
  + See Figure X for specific pin functions.
* 2-logic Analyzers
  + 68-channels possible
* Velleman Function Generator
  + Amplitude range: 100 mVpp to 10 Vpp @ 1 KHz
  + Offset: from 0 to -5 V or +5 V max
  + 8 bit vertical resolution
  + Sample rate: 12.5 MHz
  + 50 ohm output impedance
  + Frequency range: 0.005 Hz to 500 kHz
* Velleman Oscilloscope
  + Two channel DC bandwidth
  + 1 Mohm / 30 pF Input impedance
  + 30 V maximum input voltage
  + 10 mV to 3V/division input range
  + 0.3 mV display resolution
  + Records 4K samples / channel
  + Sampling frequency of 250 Hz to 25 MHz
* ADS1115 16-bit Analog-to-Digital Converter
  + 4-channels
    - Channel 0: +5 Volts max input
    - Channel 1: +15 Volts max input
    - Channel 2: -5 Volts max input
    - Channel 3: -15 Volts max input
* LT3015 Negative Linear Voltage Regulators
  + -1.22 Volts to -15 Volts output
  + Maximum 0.5 Amp output
  + .14 mV per step
  + Fused from power supply
* LT1963 Positive Linear Voltage Regulators
  + 1.21 Volts to +15 Volts output
  + Maximum 1 Amp output
  + .14 mV per step
  + Fused from power supply
* External power supply
  + Input - 120 VAC
  + Output
    - +15 Volts at 1.5 Amps
    - +5 Volts at 4 Amps
    - -15 Volts at 0.5 Amps
* Temperature range = 0*°*C - 70*°*C

# Software Specifications

Students will be able to connect to the RLS workstation via windows remote access to the IP: 128.208.255.52. A user may connect on campus or off campus using the Husky OnNet VPN. One user may to connect to the workstation at a time. On the desktop of the RLS workstation there is an executable file labeled “Remote Lab System”. This opens the RLS graphical user interface (GUI).

### *Graphical User Interface (GUI)*

Through the GUI, the user is able to check which daughter board is connected, change settings via drop down menus, send updated settings to the Arduino, open the logic analyzer software, and open Velleman oscilloscope software.

When the RLS software is first opened, daughter board settings menus are all deactivated. The only buttons available for interaction are “Check Board”, “Logic Analyzer 1”, and “Logic Analyzer 2”. This prevents a user from changing and applying settings when no daughter board, or a different daughter board, is connected.

A user must click the “Check Board” before any other interaction is possible. If no board is detected or the user has not checked board, then the user will not have permissions to changing any of the settings for any of the boards. Settings may only be changed for a board that is active.

Update board first makes sure that the board that the user is working on is actually the daughter board connected to the Arduino. If it is not, it prompts the user to check board again.

Window resizing including maximizing the screen is possible though the experiment window does not scale with window size.

### *External Software*

The buttons “Oscilloscope/Function Generator”, “Logic Analyzer”, and “Logic Analyzer 2” open their respective software. This software is provided by the respective manufacturers and is used to take measurements. A user is not allowed to open more than one process of each. If a user attempts to open one that is already open, they are told an instance is already running.

On exit, the software for the logic analyzers and oscilloscope/function generator are also all closed.

# Operational Requirements

In order to operate the system there are some key operational requirements. While this is a remote lab station designed to be used remotely, the Daughterboards must be physically cycled in and out in order for a user to change experiments. This may be done during business hours by a student or a staffed lab technician.

The Remote Lab Station requires an Electrical Engineering lab computer with the Velleman Oscilloscope and Function Generator software, the LogicPort Logic Analyzer software, and our Remote Lab Station software installed. This lab computer should not be used for any purpose other than the Remote Lab Station.

In order for the system to be operational, the Remote Lab Station computer is required to maintain an internet connection and be accessible remotely using the Husky OnNet VPN as required by UW-IT.

The remote lab system has an operating temperature range of 0*°*C - 70*°*C. It should be kept in a cool dry place and out of the sunlight. While direct sun exposure should have no effects on the system, the system does generate heat and should have the ventilation ports clear to allow for proper cooling.