# Rochester Institute of Technology

## Real Time and Embedded Systems: Project 6

**Overview:**
Design and implement an embedded, real-time stand-alone system to provide a rough indication of voltage using a servo motor.

**Analysis:**
**Signal Generator:** A signal generator is set to produce a waveform with a low frequency and limited amplitude. You are expected to use these three waveforms: sine, square, and triangle.
**Voltage Indicator:** The voltage indicator provides a rough (non-calibrated) indication of the input voltage. The indicator movement reflects the voltage changes of the signal generator. Zero voltage should be represented as a mid-point position on the servo. Counter-clockwise positions from the mid-point represent negative values. Clockwise positions past the mid-point represent positive values.

**Design Constraints:**

- The signal generator voltage is measured with the A/D converter on the "purple box" using a QNX Neutrino program. Note that you must use the 50 ohm output to get the analog voltage from the signal generator.
- The voltage of the signal generator must be constrained to -5 volts to +5 volts to protect the Diamond Systems hardware. Measure this with an oscilloscope but first verify that your scope is working correctly using the square wave 5 volt test point on the lower right side of the oscilloscope.
- The measured voltage is indicated by driving one servo using your program on the STM32 development board.
- Set the signal generator frequency low enough to allow the servo to respond in real-time.
- The frequency of the signal generator be low enough to allow sufficient time for the servo to move to the new positions. 0.5 to 1 Hertz is typical.
- A push-button on the STM32 development board is used to start the servo motor. (A motion on the joystick button is also acceptable).
- No user interface is required nor permitted except for the communication status display on the QNX Momentics console window on the lab Windows system.
- The communication mechanism between the two platforms is at your discretion. Please see the instructor if you'd like any suggestions.
- Each platform must provide a visual or audio indication of a fault condition (communication link is down, out-of-range voltage, etc.). For the QNX system the status can be text messages on the Momentics console window.

**WARNING:**
The Diamond Systems A/D converter accepts voltages between -10 and +10 volts DC, referenced to ground on the Analog I/O ports. Voltages beyond this specification will damage the hardware! Please limit your signal generator voltage to -5 volts to +5 volts DC. Be sure to confirm that you are measuring the voltage correctly by using the oscilloscope. Use the square wave 5 volt test point on the lower right side of the oscilloscope to confirm that you are measure voltages correctly. 10x probes may measure 5 volts as 0.5 volts!

**Report:**
In addition to the demonstration of your project, a brief report with the required sections is required. List the trade-offs and assumptions of your implementation. Inclusion of proof of operation is not required for this project – the demo is sufficient. Your source code must be included in your electronic submission.

**Grading Criteria:**

- Program Operation and Demo – 50%
  - Hardware setup is orderly and well organized – 10%
  - Demo sheet functions all completed – 30%
  - Demo operates without faults or restarts – 10%
- Program Design --- 15%
  - Proper initialization
  - Correct use of functions (no copy/paste/edit slightly)
  - Separation of hardware related code from pure software (e.g. the results reporting code)
- Source Code Structure and Readability – 10%
  - Appropriate use of white space – 2%
  - Consistent and good indentation – 2%
  - Appropriate comments at the function and paragraph levels (such as a for loop) – 2%
  - Following C style guide (good names, etc.)
- Report Content – 25%
  - Report is at least 2 pages (not counting pictures, cover page, diagrams) – 5%
  - Demonstrates team understands the problem, solution, and technology (hardware and software) – 5%
  - For this project it must include a complete description of the communication system design – 5%
  - Report contains all required sections (except as noted above) per the report guidelines – 10%
- Bonus Opportunity – up to 20% at instructor discretion
  - Demonstrate smooth and proportional operation of sine, triangle, and square waves over a range of voltages from 1 volt to 5 volts peak voltage
  - To accomplish this smooth operation your communication system must support substantially more than 16 levels.

- Your report must contain a thorough description of your communication system design including how many discrete levels are supported including a description of the quantization of the 1 to 5 volt signals.