University of Idaho
College of Engineering

ADVANCED INPUT SYSTEMS

BUTTON CYCLER ENHANCEMENTS FOR ADVANCED INPUT SYSTEMS

TEAM P.R.E.S.S.

ANDREW OVERBY

CODY KASPER

CHRIS CROZIER

VALUE PROPOSITION

Exhaustive testing of human machine interfaces (HMI) associated with high technology equipment is needed to assure that the HMI remain fully functional throughout the anticipated usage life.

The goal of our project is to design a next-generation keyboard testing equipment/software package that can be easily configured to a broad range of keyboard geometries.

The test will reduce human labor required for data acquisition/visualization and provide information about changes in switch health throughout the entire testing procedure.

PROBLEM STATEMENT

Develop enhancements to a button cycler for use in qualification testing of electro-mechanical switches designed into Advanced Input Systems' products.

CURRENT SYSTEM CAPABILITES

- Incremental counters detect and display # of switch closures after reset
- System force can be somewhat controlled through input pressure.
- Multiple pneumatic air cylinders (Bimbas) can test multiple keys on a device.

CURRENT SYSTEM DRAWBACKS

- No way to monitor or adjust force applied by Bimbas.
- No way to measure or quantify **switch health**.
- Switch closure count doesn't indicate *when* an error has occurred.

SYSTEM REQUIREMENTS

- Priority scale, structured as tiers (1-4)
  - 1 – LabVIEW program, debounce detection, and datalogging
    - Test 1 to 30 switches simultaneously at a rate from 1Hz to 5Hz,
    - Allow operator to assign cycle rate, and cycle count prior to test start.
    - Monitor switch health during cycling:
      - Open/Closed resistance waveform
      - Show present values of data logging during test.
      - Switch bounce that lasts >10ms
    - Allow operator to pause/resume/restart tests and save test setups.
    - Format Excel report at test end.

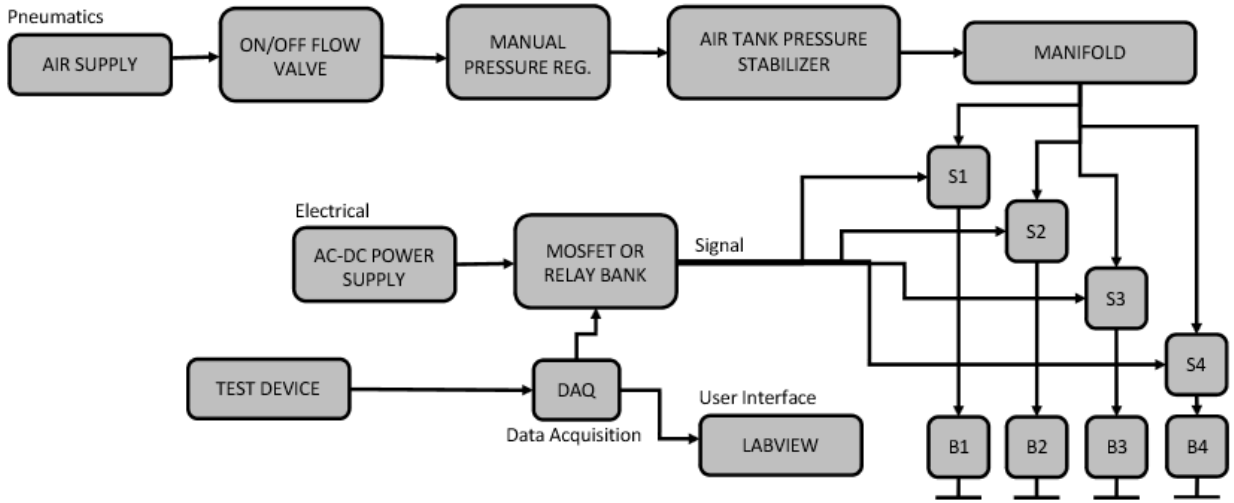
SYSTEM REQUIREMENTS

- **Priority scale (1-4), structured as tiers (lowest number is highest priority)**
  - 2 – Force input and detection
    - Allow operator to assign cycle force prior to test start.
    - Monitor maximum applied button force during cycling
  - 3 – Switch characterization
    - Characterize switch's F/D/R behavior at pre-programmed test intervals
    - Output hysteresis curve of results
  - 4 – Additional hardware redesign
    - Modernize hardware setup for button cycler system with new test apparatus

SYSTEM HARDWARE

AIS Button Cycler Enhancements

Priority 1 System Diagram

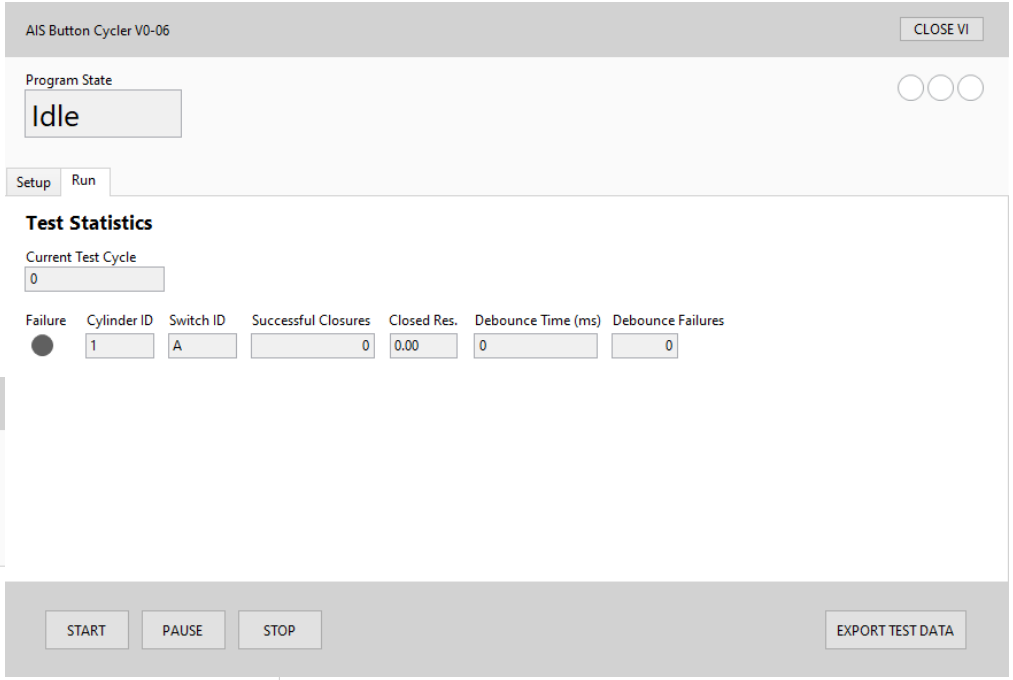


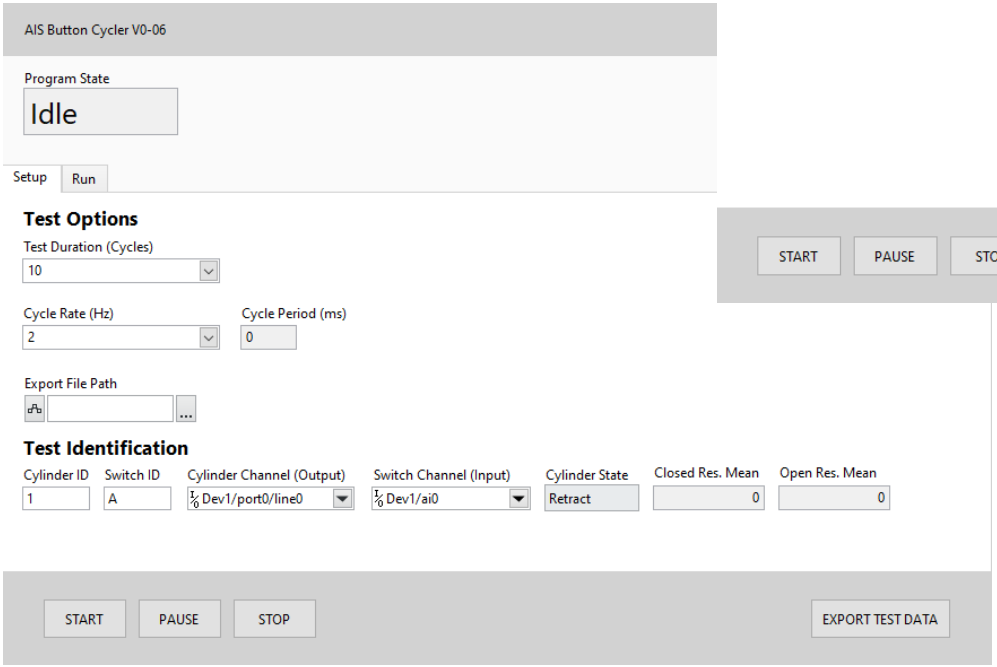
Key:
Solenoid – S
Bimba – B

SYSTEM SOFTWARE - FUNCTIONALITY

- Program structure (overview) – series of states
  - Idle
    - User can graphically assign test parameters
    - Natural state of the program when nothing is happening
  - Calibrating
    - Data on the system is obtained that is needed prior to the test
  - Testing
    - Information on switch health is recorded and displayed to the user
  - Logging
    - A brief system pause is allowed to log data to the device
  - Paused
    - So the operator can make adjustments to hardware if needed during the test
  - Complete
    - The test reached its specified number of cycles and is now finished

SYSTEM SOFTWARE – GUI



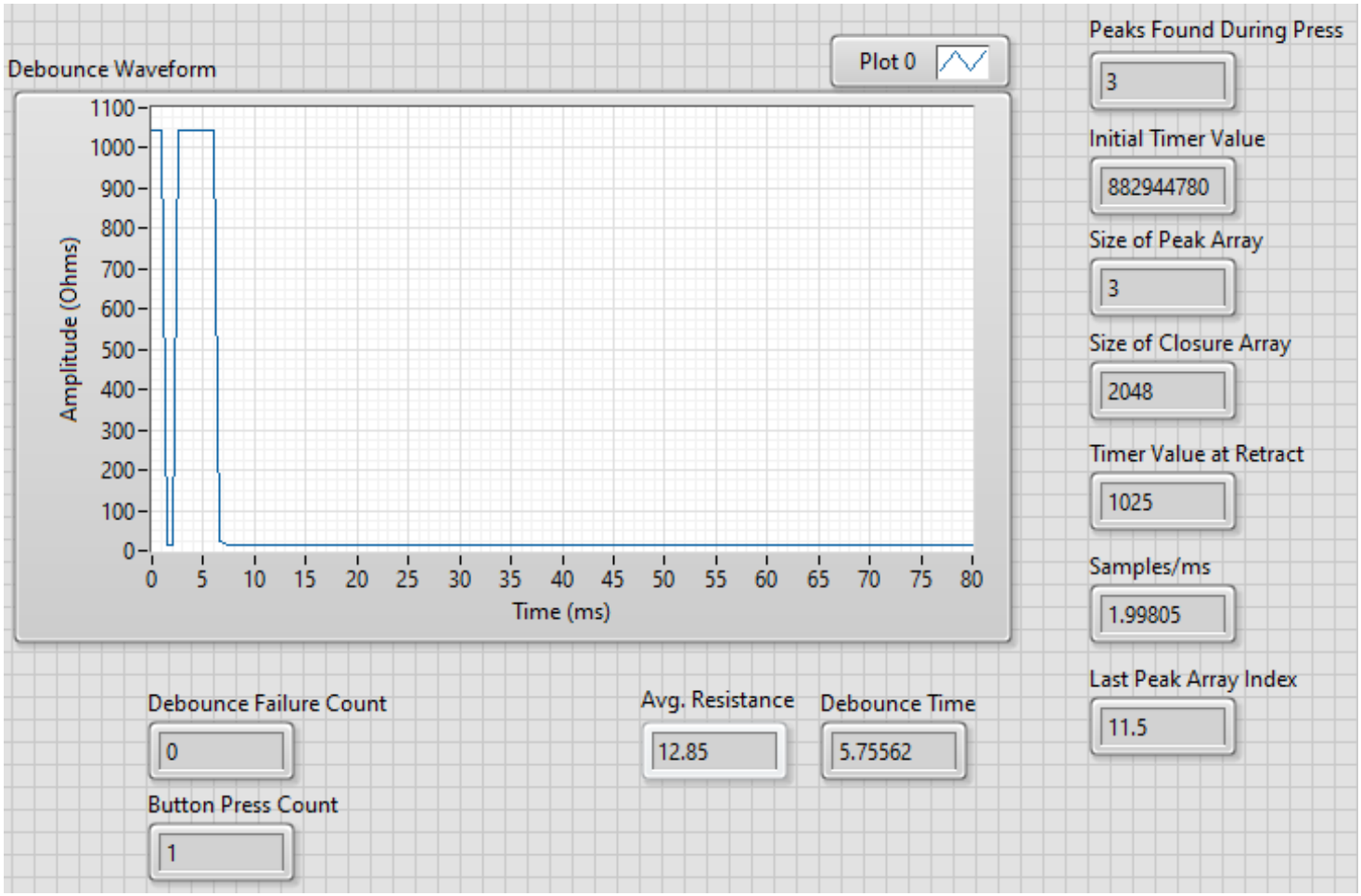


SYSTEM SOFTWARE – DEBOUNCE DETECTION

- Process flow of debounce detection
  - Cylinder actuates
  - Threshold resistance values determine when time will start/stop
  - While switch is closed, data is obtained in an array
  - Peaks in the waveform are detected
  - Upon switch release, the array stops obtaining values, and results are examined
  - Time value is extracted from the array where the last peak occurs

LabVIEW function
Peak Detector VI

TYPICAL SWITCH RESPONSE



BUDGET OVERVIEW

Capstone Project Budget Template - Fall/Spring

Project: AIS

Last Updated 12/2/2019

Expense Items	Year								Item Total
	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	
Equipment/Tools:									
									$ -
Travel:									
Travel to Cour d'a Alene	$ 100		$ 100			$ 100		$ 100	$ 400
									$ -
Supplies / Parts / Services:									
McMaster-Carr		$ 205							$ 205
Moscow Building supply		$ 17							$ 17
Amazon		$ 70							$ 70
McMaster-Carr			$ 170						$ 170
Amazon			$ 104						$ 104
									$ -
									$ -
									$ -
									$ -
Shop Usage (est. Hrs):									Hours
		15							15
									0
									0
									0
									0
									0

			Expenses
	$ 965		**Subtotal**
Graduate Student Support	$ 1,000		**including fringe**
Shop Overhead	$ 400		
University Overhead	$ 118		**5% of all expenses**
Totals	$ 2,483	$ 4,000	$ 1,517
		Budget	Excess

PROGRESS SINCE SNAPSHOT 1

1. Auxiliary air tank to stabilize pressure drops
2. 4-channel MOSFET switch to drive multiple solenoids
3. NI USB-6008 implementation for data acquisition
4. LabVIEW GUI & control
5. Switch press waveform generation
6. Debounce closure detection
7. Mean closure resistance
8. Testing actions: Start, Stop, Pause, Resume
9. Multiple inputs to the user: Test Duration, Cycle Rate (Hz), Failure Criteria (%), Resistance Threshold (Ohms), Debounce Threshold (ms), Switch & Cylinder ID
10. Data filtration for testing failures & successes