P17665 Performance vs. Engineering Requirements

ER #	Importance	Source (CR #)	Function	Engineering Requirement	Symbol	Minimum Value	Nominal Value	Ideal Value	Validation
ER 1	1	1.1, 2.2	Machining	Maximum measurable cutting force	N	400	500	>500	S1
ER 2	1	1.1, 2.2	Machining	Maximum withstandable RPM	rpm	1800	2000	>2000	S2
ER 3	2	1.3	Data Measurement	Sampling Rate per Channel	Hz	333	1600	> 1600	S2
ER 4	2	2.1, 2.4, 3.3, 3.4	Set-up	Time to attach to machine	s	90	60	<30	S3
ER 6	2	1.3, 3.3, 3.4	Data Processing	Time for user to process data	min	45	30	15	S4
ER 7	2	1.2, 1.3, 3.3, 3.4	Data Processing	Delay from data capture to viewing	s	360	180	0 (Real-time)	S4
ER 8	2	2.3	Machining	Lifespan	hr	250	300	450	S5
ER 9	3	1.2	Data Transmission	Wireless data transmission range	ft	50	100	200	S6
ER 10	3	3.1	Data Measurement	Measurement Accuracy	%	15%	10%	5%	S7

Below is a description of each requirement related to the end performance with green as completed, yellow as touched on, and red incomplete.

ER 1: Only the yellow Wheatstone bridge circuit was able to provide a usable output voltage, but the load variance showed a change in voltage of about 0.2mV per 100N. The device was able to withstand forces up to and even over 500N.

ER 2: The device has not been spun because of initial issues with the Wheatstone bridge.

ER 3: The sampling rate on the data acquisition side was set in the Bluetooth transmission code that was handled with the HC-06 module.

ER 4: Setup time attaching to the machine can be done in under 5 minutes provided there is a power supply located near the device. The standalone rechargeable batteries were unable to be implemented with the 3D housing, so a 3.3V power supply was needed to power the Wheatstone bridges.

ER 6: LabView was explored as a data processing solution but it was set to the side in order to troubleshoot Wheatstone bridge issues.

ER 7: Data captured from the bluetooth module was able to be seen in real time on energia's serial plotter software, but it was not processed any further. Real time data processing in LabView requires a separate expensive license.

ER 8: No lifespan tests were run because of troubleshooting but the expected lifespan of the mechanical device was believed to be around our nominal value of 300 hours of run time.

ER 9: A script in assembly code was written in Code Composer Studio (CCS) using an MSP430G2335 TI Launchpad and an HC-06 Bluetooth transmission module. The HC-06 was able to transmit up to 120ft. without any data loss, therefore meeting the nominal value of transmission.

ER 10: The accuracy was correlated to around 0.2mV per 100N loaded and worked in a linear fashion. The calibration curve in the tech paper shows data points to support this, as well on EDGE.

Budget: The team was able to stay under the original budget of $2,000, spending only $1,500 on parts with money left to spare. All parts were delivered to the customer and are readily available in his research lab, along with all supplies for the ImagineRIT demonstration.

The device was still able to provide a voltage differential in a transverse load case for one of the Wheatstone bridges, so there were some steps made into finding a future functioning device. There are many recommendations mentioned in the tech paper as well, but the significant changes of note would be a complete redesign of the tool accepter by making the tool attached as close as possible to the mounting point of the device.