14026 PEV Testing System

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Agenda

- Project Overview
- Customer Requirements
- Engineering Requirements
- Design Overview
- Testing the MEDIRESP V
- Conclusions
- Future Work for the Testing System

Project Overview

- Background:
  - The MEDIRESP V – a portable emergency ventilator
- Design a system that models the human respiratory system and evaluates the performance of the MEDIRESP V

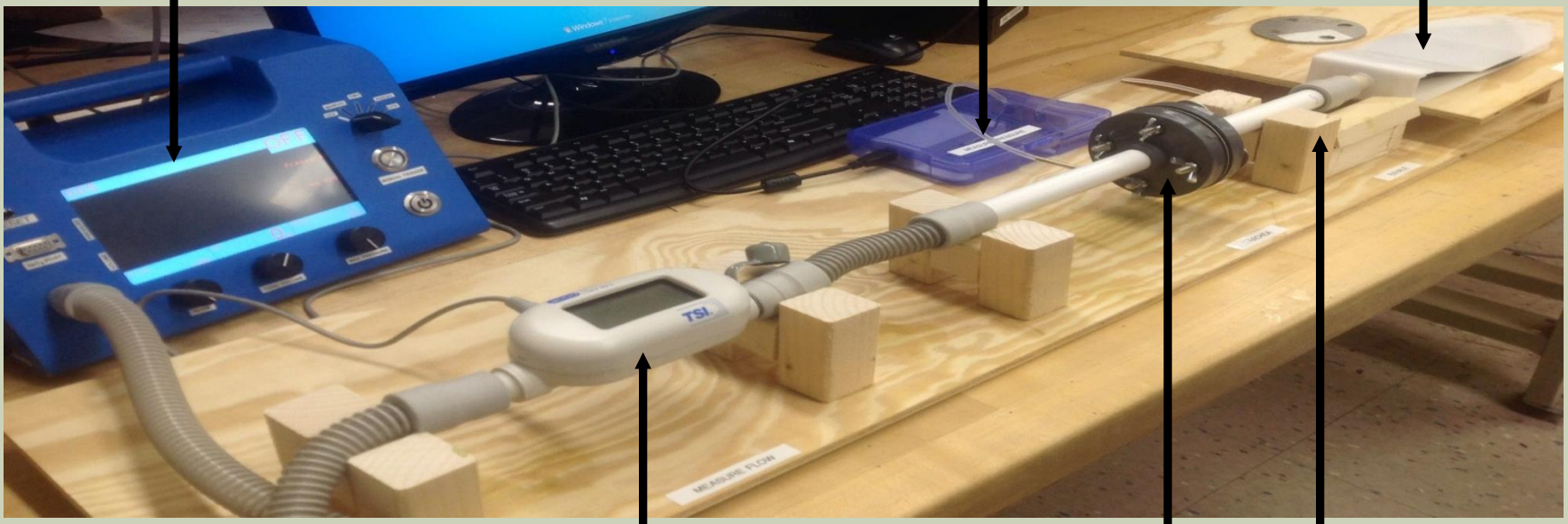
Customer Requirements

Customer Need #	Importance	Description	Status
CN1	9	Adjustable Lung Compliance	
CN3	9	Measures Respiratory Rate	
CN4	9	Measures that air pressure is always at PEEP level	
CN6	9	Measures Inspiration/Exhalation Ratio	
CN7	9	Measures pressure levels	
CN8	9	Measures max lung volume	
CN9	9	Measures flow rates	
CN14	9	Validation of PEV	
CN15	9	Test Report	
CN17	9	Validation of 4 PEV Modes	
CN19	9	Validate testing for neonatal toadult	
CN2	3	Adjustable Trachea and Lung Resistance	
CN5	3	Adjustable Tidal Volume Capacity	
CN13	3	Minimizes expenses	
CN16	3	Repeatable Test Process	

Engineering Requirements

rqmt. #	Importance	Source	Engr. Requirement (metric)	Unit of Measure	Marginal Value	Ideal Value(s)	Concluded Condition
A1	9	CN9	Leak Test Configuration 1	Lpm	<2%	0	
A2	9	CN9	Flow Rate Measurement Capability	mL/sec	+/- 1	0-100	
A3	9	CN1	Lung Compliance	mL/cmH2O		0.1	
A4	9	CN9	Leak Test Configuration 2	Lpm	<2%	0	
A5	9	CN9	Pressure Measurement Capability	cmH2O		+/- 0.1	
A6	3	CN2	Resistance of Trachea & Lung	cmH2O/L/sec		19-27	
A7	9	CN9	Leak Test Configuration 3	Lpm		0	
A8	3	CN8	Maximum Lung Volume	mL		1000	

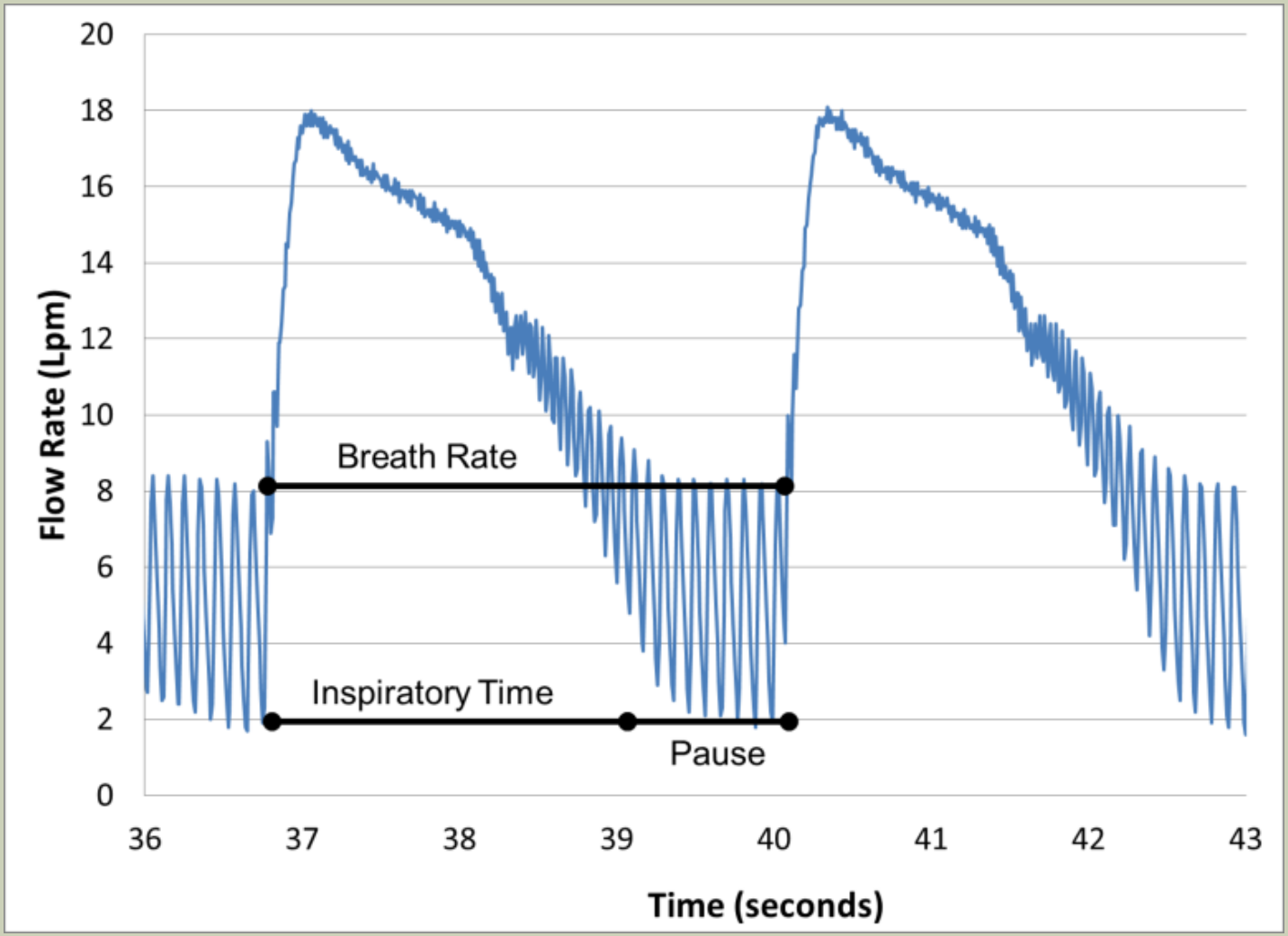
Design Overview



Testing the Mediresp V

rqmt. #	Function	Unit of Measure	Max Error	Ideal Value	Error Sources	Concluded Condition
S1	Breath Rate	bpm		0-80	1 Q Sensor Time	
S2	Inspiration Time	sec		0.3-9.9	1 Q Sensor Time	
S3	Rise Time	sec		.1-.9	1 Q Sensor Time	
S4	Tidal Volume	mL		1000	1 Q Sensor	
S5	Inhale:Exhale Ratio	-		1:1	1 Q Sensor Time	
S6	Pressure Provided	cmH2O		0-108	cmH2O	
S7	Weight	kg		<40	Scale	
S8	PEV-Human Connection					
S9	Extrinsic Peak End-Expiratory Pressure	cmH20	0.05	0-20	1 pressure sensor	
S10	Overpressure Alarm	cmH20	0.28	110	1 pressure sensor	
S11	Mean Airway Pressure	cmH2O	0.61	0-99	1 Q, 3 P	
S12	Intrinsic Peak End-Expiratory Pressure (AKA Auto-PEEP)	cmH2O	0.03	3.0-5.0	2 pressure sensors, 1 flow sensor	
S13	Automatic Mode					
S14	Manual Mode					
S15	CPR Mode				1 flow sensor's time delay	
S16	Assist Mode	mL	1	1.0-50.0	1 flow sensor	

Testing the Mediresp V



Conclusions

- MEDIRESP V needs to be calibrated properly
  - The flow rate on the display varies from a 0% error to an 87% error depending on the MEDIRESP setting
- MEDIRESP settings are consistent
- Three tests failed to fall into the desired PEEP range.
- MEDIRESP V pushes air into the system in an attempt to keep PEEP
  - If the person continues not to exhale this will fill the lungs continuously
- Compared to the user manual:
  - CPR is just a timer
  - Manual mode does not administer a breath after a certain time period
  - Does not operate at a 1:2 inhale:exhale ratio

Future Work to Testing System

- Assist mode
  - Original design calls for a syringe
  - Not sure if the syringe size that we were using shows a failure on our part or the sensitivity of the MEDIRESP
  - Syringe size of 1.3 L is required to determine if the MEDIRESP's sensitivity is inadequate, and a rate of .1 L/s will provide a good control over the amount of air removed from the system. This is achievable for about $90.
- Solenoid valve
  - Solenoid valve did not open to full position and would not allow lung to completely exhale
  - Team found a solenoid air control valve part # CAT66P-012-D manufactured by ARO to be more suitable
  - This requires Texas Instrument's DC/DC boost converter part # TPS61080/1 to step up the 5V USB supply to the ratings of the solenoid valve; achievable for about $100

Future Work to Testing System

- LabView
  - Ability to export and save all data at the same time
  - Generate a report
  - Adjust sampling time in LabView to collect pressure data at a similar rate to the physical limitations of the pressure sensor hardware

Questions?