Multidisciplinary Senior Design
Project Readiness Package

Project Title:	HV/AC Baby Stroller
Project Number: (assigned by MSD)	P18xxx
Primary Customer: (provide name, phone number, and email)	Dr. DeBartolo, Maura Keyes, and Danielle Labelle discussed possibilities of 4moms acting as the customer to the project.
Sponsor(s): (provide name, phone number, email, and amount of support)	Dr. DeBartolo, Maura Keyes, and Danielle Labelle discussed possibilities of 4moms funding and Fisher-Price alumni mentoring the project.
Preferred Start Term:	Fall 2017
Faculty Champion: (provide name and email)	
Other Support:	1 Industrial Design 1 CE 2 EE 1 ISE – Emily Heitzhaus 2 MecE – Maura Keyes and Danielle Labelle
Project Guide: (assigned by MSD)	

Maura Keyes	05/29/17
Prepared By	Date
Received By	Date

Items marked with a * are required, and items marked with a † are preferred if available, but we can work with the proposer on these.

Project Information

*** Overview:**
Please provide a brief (2-3 paragraphs) overview of the background on the problem to be solved, the motivation for solving it, the short-term goals for the proposed project, and the long-term goals for any program the project may support.

If this is a follow-on project, please include a link/reference to the prior project(s) here.

Maura Keyes began thinking after hanging up the phone from speaking with her older sister. Her sister is a young mother living in northern Alaska, and has to walk 10 minutes to work because her and her husband only have one car. She brings her baby to work with her, meaning she has to take her delicate child outside on cold days that could range anywhere from 0 [˚F] to -40 [˚F].

Infants and young children are more sensitive to fluctuations in temperature with lower heat and cold tolerances. Keyes wanted to create a stroller that could be safer, not only for her niece, but for children with outdoor lifestyles in extreme environments.

Keyes foresees this product being beneficial for countless lifestyles from the busy NYC parent that needs to do their grocery shopping in the middle of winter and wants to avoid the traffic to the Southern Californian beach lovers that want to go on a run in the summer heat.

The design of the stroller will be able to heat the baby carriage space in cold weather environments and cool the baby carriage space in hot weather environments. The design will feature an adjustable frame, capable of supporting a limited range of baby carriers for ease of user.

A start-up group has begun working on developing this technology with additional features under the name Smartbe Intellegent Stroller.
IndieGogo Page: https://www.indiegogo.com/projects/smartbe-intelligent-stroller-baby-technology#/
Video Clip: https://www.youtube.com/watch?v=maUQAAfU44I

No prior RIT senior design projects.

*** Preliminary Customer Requirements (CR):**
What attributes does the customer seek in the final project? Each CR should map to one or more ER (see below).

Designed for:

- Compatible with various baby carrier sizes
- Low-cost
- Baby/Child safe environment
- Easy to use

- Aesthetically pleasing

To be finalized in MSD with group

Objective Statement: To design a stroller that will be able to heat the baby carriage space in cold weather environments and cool the baby carriage space in hot weather environments; featuring an adjustable frame, capable of supporting a limited range of baby carriers for ease of user.			
Category	**CR #**	**Customer Object Description**	**Relative Importance**
Optimization	1.1	Frame fits a range of various width baby carriers	
	1.2	Frame fits a range of various length baby carriers	
	1.3	Frame fits a range of various height baby carriers	
	1.4	One hand to (dis)assemble stroller	
Constraints	2.1	Maintain an acceptable carriage temperature in cold weather environments	
	2.2	Maintain an acceptable carriage temperature in hot weather environments	
	2.3	Carriage space fits both infants and children	
	2.4	Any softgoods should be removable and washing machine/dryer safe	
Rules	3.1	Non-toxic materials used	
	3.2	Electrical Safety: system shut-down	
	3.3	Isolate all electrical components	
Test/Data	4.1	FEA & proof testing that frame supports the weight of an infant/child	
	4.2	Limit pinch-points	
	4.3	Thermal analysis of design and losses	
	4.4	Manufacturing plans & documentation	

† **Functional Decomposition** (will not be given to the students, but will be provided to the team's guide for reference):
What functionality will be delivered in order to satisfy the customer requirements? This may be in the form of a list of functions, a function tree or a FAST diagram.

* **Preliminary Engineering Requirements (ER)**:
Include both metrics and specifications. Each ER should map to one or more CRs (see above).
Metrics: what quantities will be measured in order to verify success?
Specifications: what is the target value of the metric that the team should design to?

To be finalized in MSD with group

- ER# 1 – Frame design, dimensions
- ER# 2 – Frame design, strength
- ER# 3 – Functionality
- ER# 4 – Manufacturing
- ER# 5 – User safety
- ER# 6 – User preferences

ER#	CR#	Engineering Metric	Marginal Value	Ideal Value	Sources
1.a	1.1	Frame fits a range of various length baby car seats	15 – 29 [in]	[in]	[1], [2]
1.b	1.2	Frame fits a range of various width baby car seats	16.5 – 20 [in]	[in]	[1], [2]
1.c	1.3	Frame fits a range of various height baby car seats	25 – 36 [in]	25 – 36 [in]	[1], [2]
1.d	2.3	Carriage space to fit infant heights	16 – 22 [in]	16 – 22 [in]	[2]
1.e	2.3	Carriage space to fit child heights	20 – 42 [in]	20 – 42 [in]	[2]
2.a	2.3	Frame to support infant weight	6 – 20 [lb]	30 [lb]	[1], [2]
2.b	2.3	Frame to support infant car seat weight	12 – 21 [lb]	25 [lb]	[1], [2]
2.c	2.3	Frame to support child weight	20 – 50 [lb]	70 [lb]	[1], [2]
2.d	4.1	FEA & proof of concept testing that frame supports total max weight	15 – 100 [lb]	100 [lb]	
3.a	2.1	Lowest outdoor temperature to maintain internal stroller environment	-40 – 55˚F	-20˚F	
3.b	2.2	Highest outdoor temperature to maintain internal stroller environment	74 – 95˚F	86˚F	
3.c	4.3	Thermal analysis of design and losses: maintain carriage temperature	55 – 78˚F	65 – 74˚F	
4.a	4.4	Manufacturing plans & documentation missing	0-2	0	
5.a	3.1	Number of exposed toxic materials used	0	0	
5.b	3.2	Electrical Safety: system shut-down			
5.c	3.3	Isolate all electrical components: charge of frame	0 [mV]	0 [mV]	
5.d	4.2	Limit pinch-points	0-2	0	

6.a	1.4	Number of hands to (dis)assemble stroller	0-2	1	
6.b	2.4	Number of softgoods that ARE NOT: removable and washing machine/dryer safe -OR- easy wipe down	0-2	0	

Sources:

[1] http://www.dimensionsinfo.com/baby-car-seat-dimensions/
[2] https://www.babycenter.com/0_your-childs-size-and-growth-timeline_10357633.bc

*** Constraints:**
List any external factors that limit the selection of alternatives, e.g., allowable footprint, budget, required use of legacy hardware/software.

- Unknown Budget & Benefactor(s)
- Need Industrial Design student to receive 4moms' help.
- Design the frame of the stroller to be compatible with various baby carriers for cross market compatibility.

† Potential Concepts: (will not be given to the students, but will be provided to the team's guide for reference):
Generate a short list of potential solutions, along with the disciplines that may be required to realize each. This helps to ensure that projects are feasible.

Adjustable knob for tightening and loosening the frame length/width to support different baby carriers
Display panel to see inside and outside carriage temperature and moisture

*** Project Deliverables:**
Minimum requirements:

- All design documents (e.g., concepts, analysis, detailed drawings/schematics, BOM, test results)
- working prototype
- technical paper
- poster
- All teams finishing during the spring term are expected to participate in ImagineRIT

Additional required deliverables:

- List here, if applicable

† **Budget Information:**
Include total budget, any major cost items anticipated, and any special purchasing requirements from the sponsor(s).

Dr. DeBartolo, Danielle Labelle, and Maura Keyes discussed possibilities of 4moms acting as the customer to the project.

* **Intellectual Property:**
Describe any IP concerns or limitations. According to RIT policy, students have the right to retain any IP they generate during a course, but some students voluntarily agree to be placed on projects where they will be asked to assign their IP. If a sponsor wishes to have a team assign their IP, we need to know ahead of time so that we can place appropriate students on the team.

In order to ensure that students can discuss their projects openly during presentations and job interviews, we ask that no more than ~20% of the project be considered confidential.

Smartbe Intelligent Stroller is developing a patent on their design. Looking into details, coverage, and range of it.

Project Resources

† **Required Resources (besides student staffing):**
Describe the resources necessary for successful project completion. When the resource is secured, the responsible person should initial and date to acknowledge that they have agreed to provide this support. We assume that all teams with ME/ISE students will have access to the ME Machine Shop and all teams with EE students will have access to the EE Senior Design Lab, so it is not necessary to list these. Limit this list to specialized expertise, space, equipment, and materials.

Faculty list individuals and their area of expertise (people who can provide specialized knowledge unique to your project, e.g., faculty you will need to consult for more than a basic technical question during office hours)	**Initial/ date**
Environment (e.g., a specific lab with specialized equipment/facilities, space for very large or oily/greasy projects, space for projects that generate airborne debris or hazardous gases, specific electrical requirements such as 3-phase power)	**Initial/ date**
Equipment (specific computing, test, measurement, or construction equipment that the team will need to borrow, e.g., CMM, SEM,)	**Initial/ date**
Materials (materials that will be consumed during the course of the project, e.g., test samples from customer, specialized raw material for construction, chemicals that must be purchased and stored)	**Initial/ date**
Other	**Initial/ date**

† **Anticipated Staffing By Discipline:**
Indicate the requested staffing for each discipline, along with a brief explanation of the associated activities. "Other" includes students from any department on campus besides those explicitly listed. For example, we have done projects with students from Industrial Design, Business, Software Engineering, Civil Engineering Technology, and Information Technology. **If you have recruited students to work on this project (including student-initiated projects), include their names here.**

Dept.	# Req.	Expected Activities
BME	0	
CE	1	Design display showing inside and outside temperatures/moisture. Send wireless signal to phone, if time permits.
EE	1-2	Circuit design & build for sensors and display.
ISE	1	Project manager. Product design for manufacturing.
ME	2	Thermodynamic/Heat Transfer devices to maintain, adjust, & monitor carriage temperature/moisture levels
Other	1	Industrial Design

*** Skills Checklist:**

Indicate the skills or knowledge that will be needed by students working on this project. Please use the following scale of importance:

1 = must have
2 = helpful, but not essential
3 = either a very small part of the project, or relates to a "bonus" feature
blank = not applicable to this project

Biomedical Engineering

	BME Core Knowledge		**BME Elective Knowledge**
2	Matlab		Medical image processing
	Aseptic lab techniques	1	COMSOL software modeling
	Gel electrophoresis		Medical visualization software
3	Linear signal analysis and processing		Biomaterial testing/evaluation
	Fluid mechanics		Tissue culture
	Biomaterials		Advanced microscopy
	Labview		Microfluidic device fabrication and measurement
2	Simulation (Simulink)		Other (specify)
	System physiology		
3	Biosystems process analysis (mass, energy balance)		
	Cell culture		
1	Computer-based data acquisition		
3	Probability & statistics		
3	Numerical & statistical analysis		
2	Biomechanics		
	Design of biomedical devices		

Computer Engineering

	CE Core Knowledge		**CE Elective Knowledge**
1	Digital design (including HDL and FPGA)	3	Networking & network protocols
2	Software for microcontrollers (including Linux and Windows)	3	Wireless networks
2	Device programming (Assembly, C)		Robotics (guidance, navigation, vision, machine learning, control)
1	Programming: Python, Java, C++	1	Concurrent and embedded software
1	Basic analog design	1	Embedded and real-time systems
2	Scientific computing (including C and Matlab)		Digital image processing
1	Signal processing		Computer vision
1	Interfacing transducers and actuators to microcontrollers		Network security
			Other (specify)

Electrical Engineering

	EE Core Knowledge		**EE Elective Knowledge**
1	Circuit Design (AC/DC converters, regulators, amplifies, analog filter design, FPGA logic design, sensor bias/support circuitry)	3	Digital filter design and implementation
1	Power systems: selection, analysis, power budget	1	Digital signal processing

	EE Core Knowledge		EE Elective Knowledge
1	System analysis: frequency analysis (Fourier, Laplace), stability, PID controllers, modulation schemes, VCO's & mixers, ADC selection	2	Microcontroller selection/application
1	Circuit build, test, debug (scope, DMM, function generator	2	Wireless: communication protocol, component selection
2	Board layout	3	Antenna selection (simple design)
2	Matlab	2	Communication system front end design
1	PSpice	3	Algorithm design/simulation
2	Programming: C, Assembly	3	Embedded software design/implementation
3	Electromagnetics: shielding, interference		Other (specify)

Industrial & Systems Engineering

	ISE Core Knowledge		ISE Elective Knowledge
	Statistical analysis of data: regression	1	Design of Experiment
1	Materials science	1	Systems design – product/process design
1	Materials processing, machining lab	2	Data analysis, data mining
	Facilities planning: layout, mat'l handling	1	Manufacturing engineering
3	Production systems design: cycle time, throughput, assembly line design, manufacturing process design	1	DFx: manufacturing, assembly, environment, sustainability
1	Ergonomics: interface of people and equipment (procedures, training, maintenance)	3	Rapid prototyping
3	Math modeling: OR (linear programming, simulation)	1	Safety engineering
1	Project management		Other (specify)
3	Engineering economy: Return on Investment		
	Quality tools: SPC		
	Production control: scheduling		
	Shop floor IE: methods, time studies		
1	Computer tools: Excel, Access, AutoCAD		
3	Programming (C++)		

Mechanical Engineering

	ME Core Knowledge		ME Elective Knowledge
1	3D CAD	2	Finite element analysis
1	Matlab programming	1	Heat transfer
1	Basic machining	2	Modeling of electromechanical & fluid systems
1	2D stress analysis	2	Fatigue and static failure criteria
1	2D static/dynamic analysis	3	Machine elements
1	Thermodynamics		Aerodynamics
3	Fluid dynamics (CV)		Computational fluid dynamics
	LabView		Biomaterials
	Statistics	3	Vibrations
1	Materials selection		IC Engines
		2	GD&T
			Linear Controls
			Composites
			Robotics
			Other (specify)