INTRODUCTION:

The primary objective of this Project Readiness Package (PRP) is to describe the proposed project by documenting requirements (customer needs and expectations, specifications, deliverables, anticipated budget, skills and resources needed, and people/ organizations affiliated with the project. This PRP will be utilized by faculty to evaluate project suitability in terms of challenge, depth, scope, skills, budget, and student / faculty resources needed. It will also serve as an important source of information for students during the planning phase to develop a project plan and schedule.

In this document, italicized text provides explanatory information regarding the desired content. If a particular item or aspect of a section is not applicable for a given project, enter N/A (not applicable). For questions, contact Mark Smith at 475-7102, mark.smith@rit.edu.

ADMINISTRATIVE INFORMATION:

- Project Name (tentative): Motorized Pediatric Stander
- Project Number, if known: P14045
- Preferred Start/End Quarter in Senior Design:
  ■ Fall/Winter ☐ Spring/Fall
- Faculty Champion: *(technical mentor: supports proposal development, anticipated technical mentor during project execution; may also be Sponsor)*

Name	Dept.	Email	Phone
Steven Day	ME	SWDeme@rit.edu	475-4738

For assistance identifying a Champion: B. Debartolo (ME), G. Slack (EE), J. Kaemmerlen (ISE), R. Melton (CE)

- Other Support, if known: *(faculty or others willing to provide expertise in areas outside the domain of the Faculty Champion)*

Name	Dept.	Email	Phone
Linda Brown, PT		Not at RIT – CP Rochester	

- Project "Guide" if known: *(project mentor: guides team through Senior Design process and grades students; may also be Faculty Champion)*

  If none other is available, then Steven Day is willing to be guide.

- Primary Customer, if known (name, phone, email): *(actual or representative user of project output; articulates needs/requirements)*
  Linda Brown / Dr. Steven Day / Single identifiable student related to CP Rochester

- Sponsor(s): (*provider(s) of financial support)*

Name/Organization	Contact Info.	Type & Amount of Support Committed
Potential gift from family of said student. SD has		~$5,000

spoken with family.		

PROJECT OVERVIEW: *2-3 paragraphs that provide a general description of the project – background, motivation, customers, problem you're trying to solve, project objectives*.

- An MSD team that ran Winter-Spring 12 worked on the lst modified pediatric stander. Team 13045 modified a purchased stander that met the majority of requirements. This project would aim to:
  - Improve upon technical shortfalls with project 13045
  - If available, incorporate an ID student to consider commercial product readiness, human factors.
  - If available, include a business student to investigate a range of business models that might allow small scale fabrication and distribution of standers.
- Shortfalls identified in last year's stander:
  - Wheels do not utilize encoder input, so stander does not travel in straight line forward or in reverse.
  - Start and stop is "jerky".
  - Proximity sensors not incorporated.
  - Remote mode not functional.

BACKGROUND FROM 2012-13 PRP for Team 13045

- Wheelchairs have been used for a long time.
  - Recent efforts to improve access to education include integration of people with physical disabilities needing a wheelchair into the classroom.
  - The motorization of autonomous control of wheelchairs has developed a lot over the past few decades.
- Standers are devices that support a person with physical disabilities in an upright position.
  - These are currently used in physical therapy settings because forcing the legs to bear weight is critical to maintaining bone strength.
  - These also provide the opportunity for students to move around and interact with other children and their environment in a more natural way.
  - There are many variations, but one of the more typical styles has large wheels on the side which are used for propulsion by the hands of the user.

Image taken from a Google search without permission – do not replicate.

- http://www.workcompcomplexcare.com/2011/02/its-always-a-difficult-to.html

- This project proposes modify an off the shelf device with motors, a controller and some human interface so that a person could control their stander, much in the same way that motorized wheelchairs are controlled, as many people with physical disabilities also do not have the arm strength or coordination to propel themselves.
- S. Day has already demonstrated feasibility of this by building one with three switches – forward, left, and right.
- There is a lot of room for improvement, including:
  - Flexibility of user (user and/or teacher or therapist) will be a potential area for interesting design. Switches, joysticks, touch screens, computer interface, visual recognition, and remote control are all commonly used methods for persons with disabilities.
  - Semi automation and safety, such as obstacle (and people) avoidance.
  - A second interface and potentially overrides by a therapist or 2nd operator seem to be a good idea. There could be some modes where the student just uses one switch for forward and a 2nd wireless interface controls steering and braking for example. There could be some modes where the student had full control, but the therapist has only a brake override.
  - If the computer that runs the system really does have these different modes, it has to be accessible by the therapist/user and easy enough to change so that you don't need engineering support.

DETAILED PROJECT DESCRIPTION:

The goal of this section is provide enough detail for faculty to assess whether the proposed project scope and required skills are appropriate for 5th year engineering students working over two quarters. The sequence of the steps listed below may depend on your project, and the process is usually iterative, so feel free to customize. Emphasis is on the "whats" (qualitative and quantitative), not the "hows" (solutions), except for the section on "potential concepts," which is necessary to assess the appropriateness of required skills and project scope. Not all of the information in this section may be shared with students. (Attach extra documentation as needed).

- Customer Needs and Objectives: *Comprehensive list of what the customer/user wants or needs to be able to do in the "voice of the customer," not in terms of how it might be done; desired attributes of the solution.*
    - Functional motorized stander for use with one specific child (to be identified by L. Brown), but that has the flexibility of inputs to be used with other children in the future or algorithm to be modified by therapist in the future.

- Functional Decomposition: *Functions and sub-functions (verb-noun pairs) that are associated with a system/solution that will satisfy customer needs and objectives. Focus on "what" has to be achieved and not on "how"it is to be achieved – decompose the system only as far as the (sub) functions are solution independent. This can be a simple function list or a diagram (functional diagram, FAST (why-how) diagram, function tree).*

- Potential Concepts*: Generate a short list of potential concepts (solutions) to realize the system and associated functions. This may involve benchmarking or reverse engineering of existing solutions. For each concept and its associated function(s), generate a list of key tasks or skills needed to design and realize the function(s), and identify which disciplines (ME, EE, CE, ISE, …) are likely to be involved in the design and realization of the function(s). See the "PRP_Checklist" document for a list of student skills by department.* ***Potential concepts, skills, and tasks should not be shared with students.***

    - The general concept and implementation from the prior team was fine, they just didn't implement everything that they'd hoped to.

- Specifications (or Engineering/Functional Requirements): *Translates "voice of the customer" into "voice of the engineer." Specifications describe what the system should (shall) do in language that has engineering formality. Specifications are quantitative and measureable because they must be testable/ verifiable, so they consist of a metric (dimension with units) and a value. We recommend utilizing the aforementioned functional decomposition to identify specifications at the function/ sub-function levels. Target values are adequate at this point – final values will likely be set after students develop concepts and make tradeoffs on the basis of chosen concepts. Consider the following types of specifications:geometry (dimensions, space), kinematics (type & direction of motion), forces, material, signals, safety, ergonomics (comfort, human interface issues), quality, production (waste, factory limitations), assembly, transport/packaging, operations (environmental/noise), maintenance, regulatory (UL, IEEE, FDA, FCC, RIT).*

ADDITIONAL

- Start and stop is not "jerky"
- Vehicle drives straight (<6 inch variation from straight over 20' travel).

FROM PRIOR YEAR:

- I'd prefer to have the students translate needs into specs and believe that they'll be able to do that with this project. I will facilitate conversations with the Physical Therapist.
- Add not more than 20# to existing stander device.
- Device operable by array of switches or controls of student/driver.
- Device has some control remotely, through existing Bluetooth device or dedicated controller.
- Safety
- Move at approximately the speed of a brisk walk (to be quantified by team).
- Able to function with a range of students
- Reliable
- Team 14045 is encouraged to completely review the EDGE project website for Team 13045; consider starting with the technical paper and the project wrapup activities to get an idea of what was accomplished and what the shortfalls were.

- Constraints: *External factors that, in some way, limit the selection of solution alternatives. They are usually imposed on the design and are not directly related to the functional objectives of the system but apply across the system (eg. cost and schedule constraints). Constraints are often included in the specifications list but they often violate the abstractness property by specifying "how".*

- Project Deliverables: *Expected output, what will be "delivered" – be as specific and thorough as possible.*
    - Functional operable stander able to be operated by student driver with some autonomous overrides (bump detection) and some remote control.
- Budget Estimate: *Major cost items anticipated.*
    - Off the shelf stander is about $3,000. Motors and controllers from hobbyist type sites are several hundred dollars.
- Intellectual Property (IP) considerations: *Describe any IP concerns or limitations associated with the project. Is there patent potential? Will confidentiality of any data or information be required?*

None held. Patent potential. No confidentiality will be required.

- Other Information: *Describe potential benefits and liabilities, known project risks, etc.*

RIT apparently is interested in a relationship with the Al Sigl Centers, of which CP Rochester is one. Good visibility.

Risk: Device must be very safe as

- Continuation Project Information, if appropriate: *Include prior project(s) information, and how prior project(s) relate to the proposed project.*

STUDENT STAFFING:

- Skills Checklist: *Complete the "PRP_Checklist" document and include with your submission.*
- Anticipated Staffing Levels by Discipline:

Total of 5 students anticipated

Discipline	How Many?	Anticipated Tasks
ME	2	Mechanical modification and system integration.
ME or EE	1	Sensor design and implementation.
EE or CE (or possibly ME not scared of programming)	1	Implementation of control algorithms onto micro-controller. Implementation of motor control and micro-controller.
ISE	0-1	Design of user interface and human factors.
ID	1	

Business student?	1	

OTHER RESOURCES ANTICIPATED:

Describe resources needed to support successful development, implementation, and utilization of the project. This could include specific faculty expertise, laboratory space and equipment, outside services, customer facilities, etc. Indicate if resources are available, to your knowledge.

Category	Description	Resource Available?
Faculty	**S. Day - Mechanical engineer**	☒
	Linda Brown – Physical Therapist and CP Rochester's Augustin Children's Center	☒
		☐
Environment	**Space in 09-2100 as needed.**	☒
	MSD space on 4th floor would be preferred	☐
		☐
Equipment	**Existing functional stander will be available to team for study.**	☒
		☒
		☒
Materials		☐
		☐
		☐
Other		☐
		☐
		☐

Prepared by: Steven Day Date: Aug. 1 2013