

Senior Design Project Description

Company Name	NC Transportation Museum	Date Submitted	Nov 15, 2017
Project Title	STEM Exhibit on Energy and Sustainability (NCTM_STEM)	Planned Starting Semester	Spring 2018

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project. 250 hours are expected per person.

Complete the following table if this information is known, otherwise the Senior Design Committee will develop based on the project scope:

Discipline	Number	Discipline	Number
Mechanical	5	Electrical	2
Computer		Systems	
Other ()			

Project Overview:

This is a project to design and build a STEM exhibit for the NC Transportation Museum located in Spencer, NC. The Museum was founded in 1977 and is celebrating their 40th Anniversary in 2017. The NC Transportation Museum Foundation is a 501 3c non-profit group that provides support for the preservation and educational programs at the museum. Partial funding for this Project was generously provided by the Bosch Community Fund (<http://csr.bosch.us/>)

In fiscal year 2016-2017, the museum logged 198 school groups bringing a total of 6,566 children who came through on organized tours. Overall attendance for 2016-17 was 118,437 (child total was 43,111).



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The museum continues to grow and saw a 15.7% increase in attendance over the past fiscal year. The museum has a variety of exhibits related to the history and science behind transportation with an



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emphasis on Rail transport.

Aerial Photo of NC Transportation Museum:



More information about the history of the museum can be found in Appendix B. The Museum's website is <http://www.nctrans.org/>.

The objective of this project will be to design and develop a STEM focused exhibit for the museum that communicates issues about energy sources and sustainability. The project is planned to be kicked off in January 2018 and will be completed in December 2018. The project will be staffed by a team of UNC Charlotte Senior engineering students. These students will be supported by a Faculty mentor and a member of the museum's Educator staff. The student labor would be provided by UNC Charlotte as part of the Senior Design Program. The estimated labor hours provided without charge from the students would be 1000 to 1500 hours.

As background, in August 2017, Senior Design kicked off another separate project with the Museum to do design work related to the conversion of a diesel locomotive train from a diesel powered energy source to battery power. The long term vision is to demonstrate the technical feasibility of a battery powered train in commuter service. This type of application would reduce the amount of air pollution that exists in urban corridors. Because of the typical shorter distances in commuter service, it is believed that battery power is a realistic option. The Project is designing wireless charging stations that can recharge the batteries when the locomotive pulls into each stop, so the train can safely complete its route.



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As the Fall 2017 project progresses, we will seek to include results from it into the January launch project. The Fall 2017 project is focused on replacement of non-renewable, polluting energy sources with clean energy that can be produced from renewable sources such as wind or solar. We think that this information will be very eye opening for students. They are likely very familiar and aware about electric automobiles, but likely few are aware of the possibilities of a battery powered train.

Project Requirements:

Electric trains can be powered by a variety of energy sources. This could include renewable sources, but they can also be powered by fossil fuels or nuclear power. In this interactive exhibit, student visitors will experiment with different sources of power for rail transportation. Each source of power represents a different set of technical and societal trade-offs. The desire is to provide STEM based education for the students regarding energy alternatives, environmental impact and rail transportation.

The train in the exhibit will be based on Charlotte's light rail system, CATS. The exhibit is planning to use a CATs train model in the exhibit because it is the largest light rail system in North Carolina. A large expansion of this system is planned in March 2018, so that event will drive interest in CATs which should make the exhibit more likely to capture the student's attention.

The interactive exhibit would be a case containing a working model of a light rail vehicle on a circular track, and 3D models of different power sources:

- Wind turbine
- Solar farm
- Nuclear plant
- Coal plant
- Natural gas plant
- Other renewable sources as appropriate

Visitors will select a power source with a large, illuminated push-button. They then will do something physical to "produce power" using the selected source. For example, turning a crank to generate electricity to power a lamp (which will simulate the Sun) to generate photovoltaic electrical energy. These tactile experiences will be designed to maximize the engagement of children to being able to physically interact with the exhibit. Each power source should have a physical model to drive home lessons about how the energy is created and what the environmental impact is. For example,

- The wind turbine spins when a student selects that energy source. An airstream would be activated which would drive the wind turbine to spin and create electrical energy.
- A lamp illuminates to "power" the solar panels would be activated when students choose solar power.
- Projected smoke flows from the coal or natural gas plant when the fossil fuel options are chosen



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- Nuclear would have to be developed as well – perhaps an inexpensive tablet integrated in the display that show and animation of a nuclear power generation.

As the power source activates, a battery graphic “charges.” When full, the train leaves the “charging station” and makes several laps around the track as the battery is slowly used up. Using information from the Fall 2017 project on a battery powered locomotive, when the train pulls into a station the student will initiate a wireless charging station to re-charge the locomotive batteries. A display indicates to the visitor the annual emissions per passenger, depending on the power source used. Each different power source would have a different impact shown which will help the students to understand trade-offs in technology.

A second display will tell the visitor how much emissions would be produced if that passenger drove an automobile instead. When the battery is empty, the train stops in the charging station again to be recharged.

This initial statement of work will be given to the UNC Charlotte Senior Engineering team as a starting point for the project definition. The engineering students will be encouraged to use their creativity to fully define this concept in a way to maximize the interactive STEM education provided to the students concerning energy production, alternatives and trade-offs among alternatives.

During the first semester (January to May 2018), the engineering students will develop conceptual designs for the interactive exhibit and during design reviews, present the details to their faculty mentor and the museum educator. After selection of the design concept, the students will work to fully design the exhibit including drawings and bill of materials. At the end of the first semester, the students will exhibit their design accomplishments at the Senior Design Expo on the UNC Charlotte campus. This Expo is open to the public and student groups participate as part of their extracurricular STEM education activities.

During the second semester (August – December 2018), the students will implement their design by ordering parts, making parts and building the exhibit. If possible (depending on size constraints), the students will exhibit their work at the December 2018 Senior Design Expo at Charlotte. Once the Expo is complete, the exhibit will be transported to the Museum to be installed in its new home location.

Expected Deliverables/Results:

- A completely functional exhibit ready to go to the museum floor delivering the functionality described above.

Disposition of Deliverables at the End of the Project:

After the Expo, deliver the exhibit to the museum

List here any specific skills, requirements, knowledge needed or suggested (If none please state none):

- Travel to the NC Transportation Museum is required for data gathering and Design



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Reviews, unless technical supporter desires to come to campus.

- Interest in STEM education and sustainability