INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	*Belmont Trolley, Inc*	**Date Submitted**	*04/20/2023*
Project Title	*EV Trolley Prototype* ***(TROLLEY_BATT3)***	**Planned Starting Semester**	*Fall 2023*

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills.

Discipline	Number	Discipline	Number
Mechanical	3	Electrical	2
Computer	1	Systems	

Company and Project Overview:

In 1911 leaders at Southern Power Company, William States Lee and James Buchanan "Buck" Duke, built the Piedmont and Northern Railway (P&N), an electrically-powered, interurban rail system linking major cities across the Piedmont of the Carolinas. The arrival of the railway created unprecedented growth in North Carolina's textile industry.

One of P&N's busy divisions ran 24 miles between Charlotte and Gastonia, NC. In 1916, at the request of Belmont's booming textile mills, P&N added a three-mile route from its main line near the city of Mount Holly to downtown Belmont. Along these tracks, three small, city-style trolley cars carried passengers and workers between the mills and the main line.

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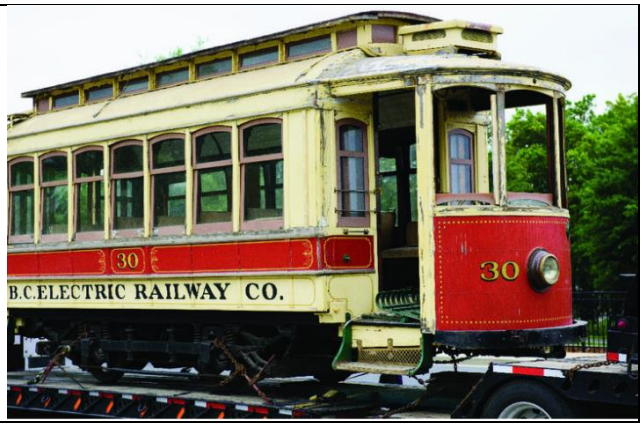

Although P&N continued its freight service in the region until the late 1960s, Belmont's streetcar service ended in 1932. When complete, the historic Trolley will run from downtown Belmont, N.C., to Belmont Abbey College, shuttling up to 20 commuters, residents and visitors at a leisurely pace. The line will run parallel to the Belmont Rail Trail, a greenway following the path of the Carolina Thread Trail through Belmont. Trolley Car 30 was built in 1912 by J.G. Brill Company, the Trolley was shipped from Porto, Portugal, where it ran faithfully until the 1980s. In the 1990s, Car 30 returned to the U.S. to launch a trolley project near Portland, Oregon. But the project never materialized and the car sat idle until it was acquired by Fraser Valley Heritage Railway Society in Surrey, British Columbia, Canada. Fraser Valley had the Trolley for 10 years before deciding to sell it. Through a tip from a friend, the Belmont Trolley organization made the purchase and arranged for Car 30's long transport from Surrey to Belmont. Here, the renovated Trolley will embark on a new journey of service. Belmont Trolley, Inc. is a non-profit corporation based in Belmont, NC. We are in the business of preserving and operating historic streetcars (trolleys) for the purposes of attracting tourism and economic development in the Charlotte region.

This Project Is the third phase of projects that UNC Charlotte Senior Design has done In co-operation with Belmont Trolley. This third project will build on the results of the prior two projects.

Project Requirements:

Belmont Trolley has been working with the University of North Carolina at Charlotte for the past two years to design a prototype EV battery cart to supply power to a historic set of trolleys our non-profit is seeking to run in Belmont, NC. Traditionally, like modern streetcars and light rail vehicles, trolleys did not have their own power source so they extracted power from an overhead set of power lines to provide electricity to the vehicles' electric motors.

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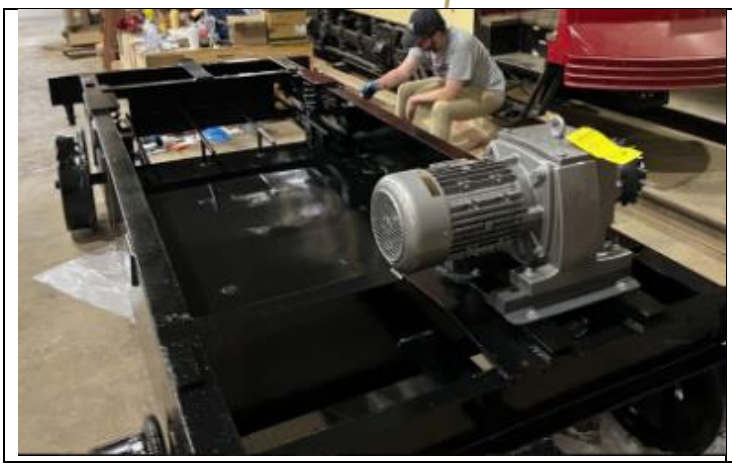

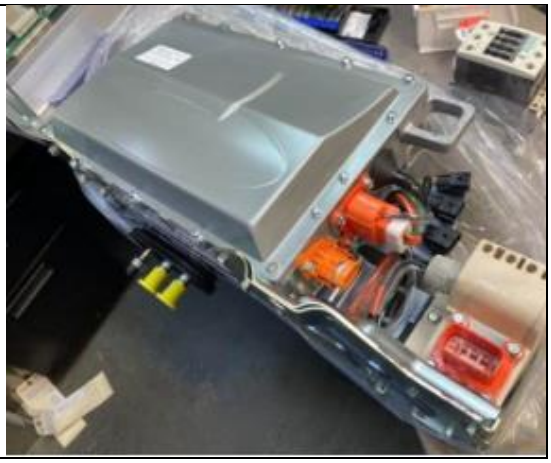

The cart developed by the UNC Charlotte Senior Design program over the last two years has remedied the need for Belmont Trolley to be able to power its historic streetcars without the need for an expensive and complex system of overhead wires to provide electricity. However, the desire has always been to power these trolleys without the need for a tow-behind cart and to incorporate the energy source on to the cars themselves.

Since incorporating EV battery technology into an existing set of historically restored streetcars would require destroying the historic integrity of the cars and be an expensive endeavor to disassemble and retrofit new technology on to the cars, our organization decided the best approach would be to acquire an another historic streetcar body and use a historic set of streetcar trucks, that our organization owns, to build out a prototype trolley that maintains its historic aesthetics but incorporates the EV technologies that were designed for Belmont Trolley's power cart into the trolley/streetcar itself.

One objective of this program is to drive down the costs of restoring and even building streetcars, or other self-propelled railcars. Our organization has discovered, like many organizations, that trying to find or replicate historic trolley parts is both expensive and time-consuming. We believe we can significantly drive down the cost of restoration by using available ac motor and motor controller equipment and forego the larger, more expensive dc motors and motor controllers that were traditionally used. Also, with the battery power system mounted on the car itself, we can eliminate the need for a set of expensive tow-behind carts to provide power to the trolley's traction motors.

Another driver for our organization to sponsor this program is to promote new technologies and to continue to support UNC Charlotte's engineering programs. Charlotte's multi-disciplinary team of faculty are looking to integrate several of their ongoing research programs into autonomous rail vehicle research. We see this as an exciting opportunity for the school to become a leader in the autonomous rail research market and for Belmont Trolley to creatively add new cars to its fleet in anticipation of future expansion of operations along the rail corridor that runs through much of Gaston County.

Expected Deliverables/Results:

Note: We expect that this trolley buildout will take more than one calendar year to complete, so the objectives for the 2023-2024 Senior Design team are:

- Provide a systems level plan to address the car's electrical, mechanical, and structural needs to make the car operational and adaptable to modern electrical control and navigations systems to potentially turn the car into an automated rail vehicle.
- Assess track profiles to determine power (battery) needs for the car.
- Evaluate two sets of trucks owned by Belmont Trolley to best meet trolley needs for structural support, motor adaptability, and braking adaptability.
- Choose and design first iteration braking system which could include: dynamic, pneumatic, or manual braking and research possibilities of alternative braking systems such as hydraulic or electrical.
- Determine horsepower requirements for AC motors and determine preliminary motor voltage ratings (230Vac vs 460Vac).
- Investigate and recommend charging options to include wireless technology being developed by UNCC faculty and grad teams, or hardwired charging systems. Depending on the motor selection, determine charging system capabilities for 400V to 800V charge levels.
- Recommend motor controllers to provide optimal power and controllability for potential automation.
- Provide schematic elevation plans and floor plans of the car for historical records.

Disposition of Deliverables at the End of the Project:

Students are graded based on their display and presentation of their team's work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter's location, it must be returned to campus for the Expo. After the expo, the team and supporter should arrange the handover of the work product to the industry supporter. This handover must be concluded within 7 days of the Expo.

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

- Interest in EV technology
- Interest in rail transportation