

# Wheel Hub Redesign and Implementation of Speedometer on the Off-Road Vehicle



Jonathan Ely & Jordan Mangham  
Advisors: Dr. Schultz, Mr. Mullis, Dr. Barnett, Dr. Gill

ECE/MAE Department, School of Engineering,  
Mercer University, Macon, GA

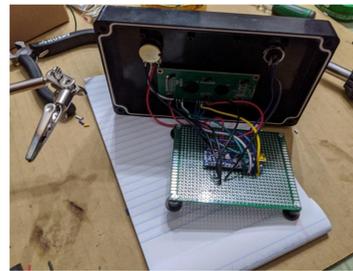
## INTRODUCTION

Mr. Mullis tasked our team with redesigning the front wheel hub assemblies and implementing a speedometer on the vehicle. The new wheel hub assemblies are expected to reduce friction and overall vehicle weight, in the hopes of increasing the vehicle's max speed. The speedometer will provide the driver an accurate description of the vehicle's instantaneous speed. Ultimately, this can be used for later projects to determine how future vehicle modifications have influenced the vehicle's max attainable speed.

## METHODS

The fabrication of the hub assemblies required over 30 hours of machining time to complete. By machining the hub from one piece of stock, the assemblies will have the maximum strength possible. The hub assemblies met the primary goal of reducing weight from the vehicle. The total build weight was 3.7 pounds or ¼ pound lighter than the original hub. With both assemblies this yields ½ pound of weight reduction. Due to the Covid-19 pandemic, performance testing of the wheel hubs could not be performed. However, it is the opinion of Mr. Mullis and the team, that with the thicker design the hub should not fail under driving loads. As the weight was less than the old hubs, the team deemed the hub assemblies a success.

Our fabricated speedometer design used an Arduino Nano copy, manufactured by Elegoo, as the microcontroller and brains of the circuit. We interfaced the Nano with a Hall sensor to determine the vehicle's speed and distance traveled. We have also implemented a battery level indicator. This information is displayed on an LCD screen providing the driver with speed, distance traveled, and remaining battery level. Lastly, a trip reset button and a knob to adjust screen contrast have been included. Everything for the speedometer is housed in a waterproof project box, and sealed with silicone to ensure water resistance.



## RESULTS

The wheel hubs were completely fabricated prior to the COVID-19 pandemic restrictions. However, we were unable to test the hubs on the vehicle under driving conditions. We did however pass client expectations by reducing the weight and including a true bearing system. We were able to reduce the weight of each hub by ¼ lb., resulting in about ½ lb. total weight reduction between the two hubs.



The speedometer was also completed, with some modifications due to inability to access the vehicle due to the COVID-19 pandemic. We were unable to complete the relay circuitry or place the mounting hardware onto the speedometer housing. Due to COVID-19 restrictions, we did not have access to the vehicle so we could not determine the final mounting location for these



## CONCLUSIONS

The final deliverables meet all specifications provided by the client. Mr. Mullis approved the aesthetic look of the hubs after they were finished. Without testing, the team is unable to fully assess any potential weaknesses that may be present in the hubs. Additionally, the speedometer meets all specifications provided by the client. Although, without accurate testing of the speedometer on the final vehicle, we cannot fully verify the accuracy. But we believe that our rough testing on a personal ATV provides adequate promise that the fabricated design will be accurate in its final application on the Mercer off-road vehicle. With proper testing of wheel circumference and fitment onto the vehicle, we believe the speedometer will meet all client specifications.

## Acknowledgements

We would like to thank Mr. Mullis for allowing us to work on the vehicle, and for all his help in the machine shop. We would also like to thank Blue Bird Corporation Engineering Group for guidance on how to implement a speedometer. We would like to thank Chase Benson, a personal friend, for all his help debugging the speedometer program. Lastly, we would like to thank our faculty advisors who helped us along the way.