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Fatigue Testing Device

Background and Objective

The term “cyclical loading” describes a case in which stresses and strains applied to an object fluctuate in a repeating pattern. In these specific cases with repetitive loads, such as in a car axle, structural components can be fatigued and fail under forces that could typically be considered negligible. The MENG 302 Lab for Mechanics of Materials would greatly benefit from a fatigue test device to teach a lab exercise with this type of material failure, however, test devices currently on the market cost in the range of $20,000. This design team is building a similar device from scratch to test fatigue failure of samples under cyclical loading at a fraction of market cost.

Device Components

- DC brushless motor with a driver that can operate safely from 0-4000 rpm
- A series of hall-effect sensors that can measure rotations and speeds of the collet holders to record data and detect failure
- A plate and screw system to apply a measurable load
- A load cell to measure and digitally record the applied force
- A limit switch on the casing to shut down the motor if the lid of the device is opened during operation
- An LED indicator to show when the specimen fails
- A range of collets that accommodate up to ¼” diameter test specimens
- Total footprint of 24” by 8” of tabletop space

Fig 1. Fatigue Testing Device mid Assembly

Previous Work and Recent Progress

In the previous semester (Fall 2019), team focus was placed on searching for appropriate parts with the intent to have the device ready for assembly at the start of this semester, torque calculations were also performed. However, it was discovered early this semester that many parts were missing. With the extra time, the team performed calculations to determine how many cycles a specimen would take to fail, and the minimum stress needed. This Spring semester has been spent re-ordering missing parts and assembling as much as possible from the parts the team did have on hand. At this time, all remaining components have arrived on campus, welding on the external frame is complete, and progress is being made on wiring together the essential sensors.

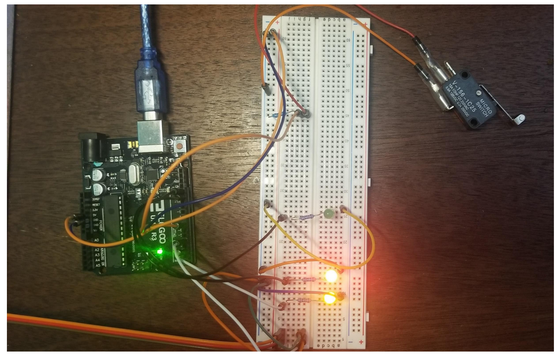

Fig 2. Prototype Circuitry for the sensors

Future Work

During the next semester (Fall 2020), the team will accomplish the following:

- Mount electronics into the completed outer frame
- Test the prototype and troubleshoot any possible malfunctions
- Define the MENG 302 Lab exercise process and objectives
- Create a lab operations manual for student use

Team Photo (L to R):, Eli Jackson (Team Lead), Isaiah Benson, Adam Murrell (SO), Nathan Paul (PO)

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