Group 2: Aditya Aji, Angelo Diggs, Sahil Khan, John Porter

DALHOUSIE UNIVERSITY
FACULTY OF ENGINEERING

Electric Bike Conversion

Department of Electrical & Computer Engineering

Background

Light-duty vehicles were responsible for about half of the GHG emissions in the transport sector.[1]

Our aim is to create an electric bike conversion kit which can be retrofitted to any standard bicycle in hopes to replace light-duty vehicles.

This will provide uphill pedal assistance[2], downhill speed control, and regeneration of energy through motor braking.

Our system will enable more people to use an environmentally friendly and more energy efficient mode of transportation.

Design Objectives

- Design a MOSFET bridge circuit as a 3 phase power inverter amplifier to convert DC battery current into 3 phased AC for the motor
- Design a motor control software to produce Pulse Width Modulated signals used to drive the MOSFET bridge (increasing duty cycle increases power delivered)
- Design regenerative braking software that reverses the motor polarity allowing it to act as a generator

Software Architecture

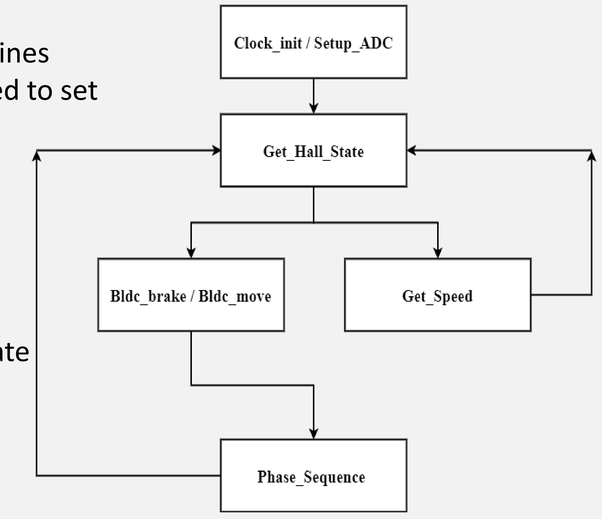
Setup Module:
- Sets the data direction for the pins as well as enabling them for reading or writing.
- Enables timers and interrupt service routines
- Initializes analog to digital conversion used to set PWM duty cycle

Get Hall State Module:
- Outputs the hall state read from the Brushless motor hall sensor signal to find current speed and rotor position

Brushless DC Move/Brake Module:
- Calls function to set the coil excitation state of the motor based on the hall state read

Get Speed Module:
- Calculates and displays current speed

Phase Sequence Module:
- Sets the phase of the motor



Hardware Architecture

DC-DC Converter:
- Steps 48V to 12V

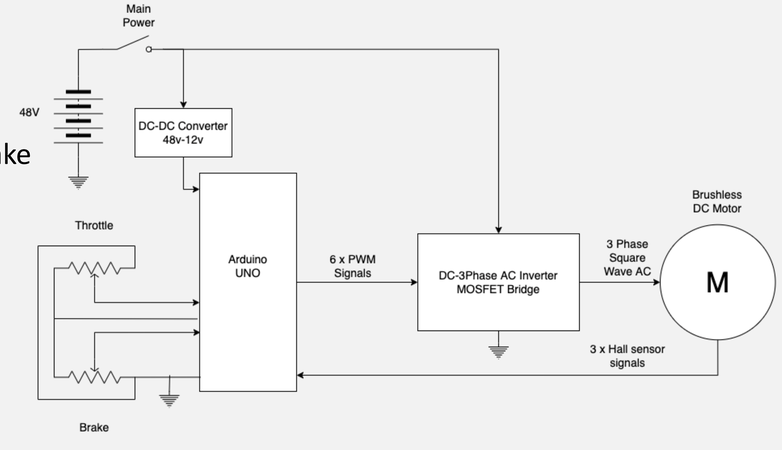
Throttle Control:
- Controls speed of the bike

Brake Control:
- Controls the amount of brake applied

Arduino UNO:
- ATMega328P based microcontroller

MOSFET Bridge:
- 3 phase power amplifier

BLDC Motor:
- Prime mover for the bike



Results

- Created a MOSFET bridge which successfully functioned as a 3 phase amplifier in the system
- Created motor control code which successfully controls the motor
- Successfully implemented regenerative braking by reversing motor polarity in the software
- Output speed reading for use in future user interface

Future Work

- Develop a test to precisely measure amount of power regenerated by brakes
- Create a PID control to implement cruise control
- Design and implement custom hardware components such as throttle and brake
- Find an LED screen for user interface and implement it with software

References

- [1] M. Bubbers, "How much do cars really pollute?," The Globe and Mail, 2 August 2019. [Online]. Available: https://www.theglobeandmail.com/drive/mobility/article-how-much-do-cars-really-pollute/
- [2] Jamie, “8 Benefits of Using Electric Bikes," [Online]. Available: https://www.skipeak.net/blog/8-benefits-of-using-electric-bikes