Project 4: Motor Control

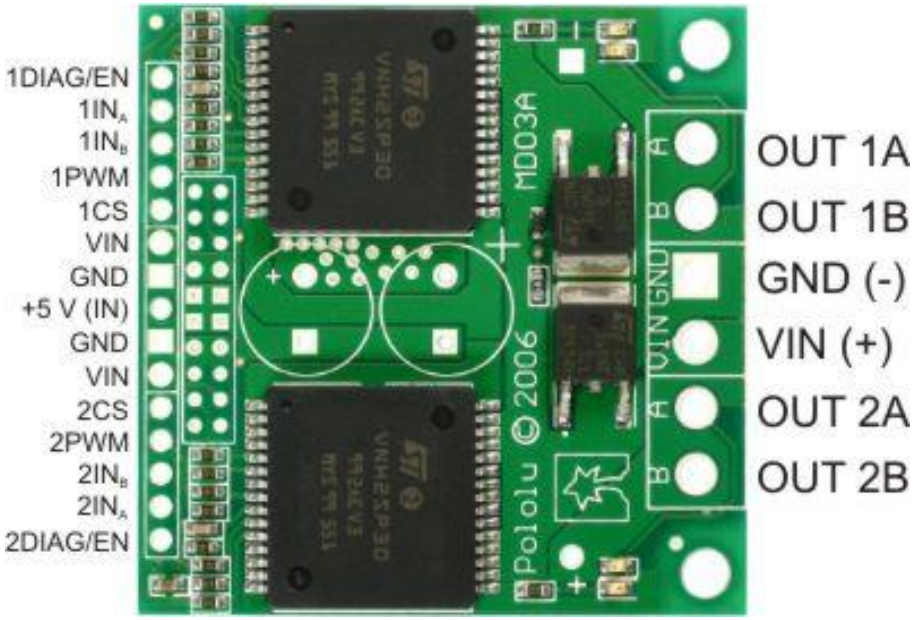
Project 4: Motor Driver Control

Four ducted fans for our hovercrafts:

- Three lateral fans:
  - Brushed motors
  - Bidirectional control
  - H-Bridges
- One lift fan:
  - Brushless motor
  - Unidirectional control
  - Electronic Speed Control (ESC) unit

Component 1: Circuit

- Right side:
  - H-bridge to battery power
  - H-bridge to fans
- Left side: H-bridge to Teensy
  - Teensy power (+5V) and ground
  - For each fan: PWM magnitude and 2 direction control signals
    - Lift fan: hard-wire direction to push air into the lower chamber



Be careful with direct battery power!

Component 2: Supporting Types/Implementation

Top of program:

```
// Promise that we will implement this function later void fsm_step();
// Create a task that will be executed once per 50 ms
PeriodicAction fsm_task(50, fsm_step);

// Gains to be used for reverse thrust
const float FAN_GAIN[] = {1.0, 1.0, 1.0};
```

Loop:

```
void loop()
{
        // Check to see if it is time to execute the fsm_task
        fsm_task.step();
}
```

Component 3: Interface Functions

```
int16_t clip(float value, float min_value,
             float max_value)
```

```
void set_lateral_fan_magnitudes(float magnitude[3])
```

- Each magnitude in the range -127 … 127
- For reverse thrust: magnitude is multiplied by corresponding FAN_GAIN before setting the PWM duty cycle

Setting PWM Duty Cycle

analogWrite(pin, duty);

- pin = Arduino pin
- duty in [0 … 255] (0% to 100%)

- Note: negative duty cycles do not make sense

Component 4: Finite State Machine

fsm_step() will implement the following behavior:

When switch is pressed:

- Lateral fans:
  - Ramp left up to 25% duty cycle, then down to -25%, then 0%,
  - Right: same sequence
  - Back: same sequence

Coding

- fsm_step():
  - Called once every 50ms
  - Do not include for, while or sleep. Instead, rely on the fact that the function will be called regularly
- Make sure that each function that you implement does exactly what the specification says & no more
- Stick to the documentation specification

New Hardware to Install

- Dual H-Bridge modules
- Be careful with the battery power! (go slow)

- New central fans will be installed over the next 2 weeks (see Zach to schedule this)