CS5780 Project Proposal

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Description:

We will build a robot that can balance on two parallel wheels with no external support. It will use a PID loop with an inertial measurement unit (LSM6DS3 IMU) as input to control two motors (DAGU yellow gear motors). Each motor will potentially also be running its own PID loop to independently control speed. We will also have a custom designed microcontroller pcb (STM32F071) and motor encoder pcb. The motors, pcbs, and IMU will be mounted on a chassis fabricated out of laser cut wood and/or acrylic. Extraneous stretch goals include increased robustness, remote control, laser sensing.

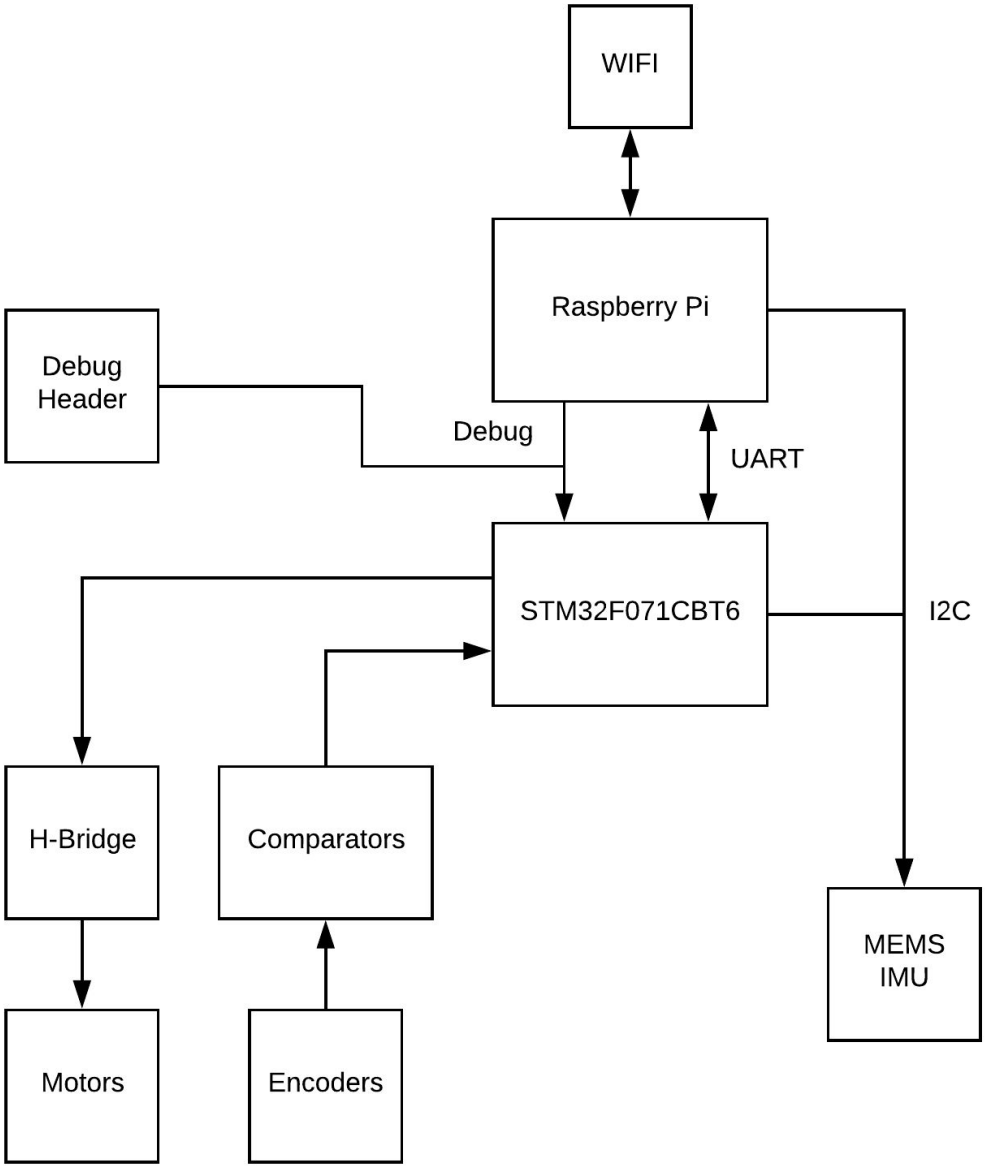
The motor encoder PCB is mounted on the end of the DAGU gear motor. Each encoder has two IR reflectance sensors. These reflectance sensors sense transitions on a black and white encoder wheel mounted on the rear output shaft of the motor. To give a quadrature encoder signal, these sensors are positioned to emit signals 90 degrees out of phase from each other.

The custom microcontroller board collects all the necessary parts and peripherals (microprocessor, IMU, debug header, h-bridge, etc) and conforms to the Raspberry Pi HAT standard. It will connect to and control the two motors by reading from the motor encoders and running a PID control loop.

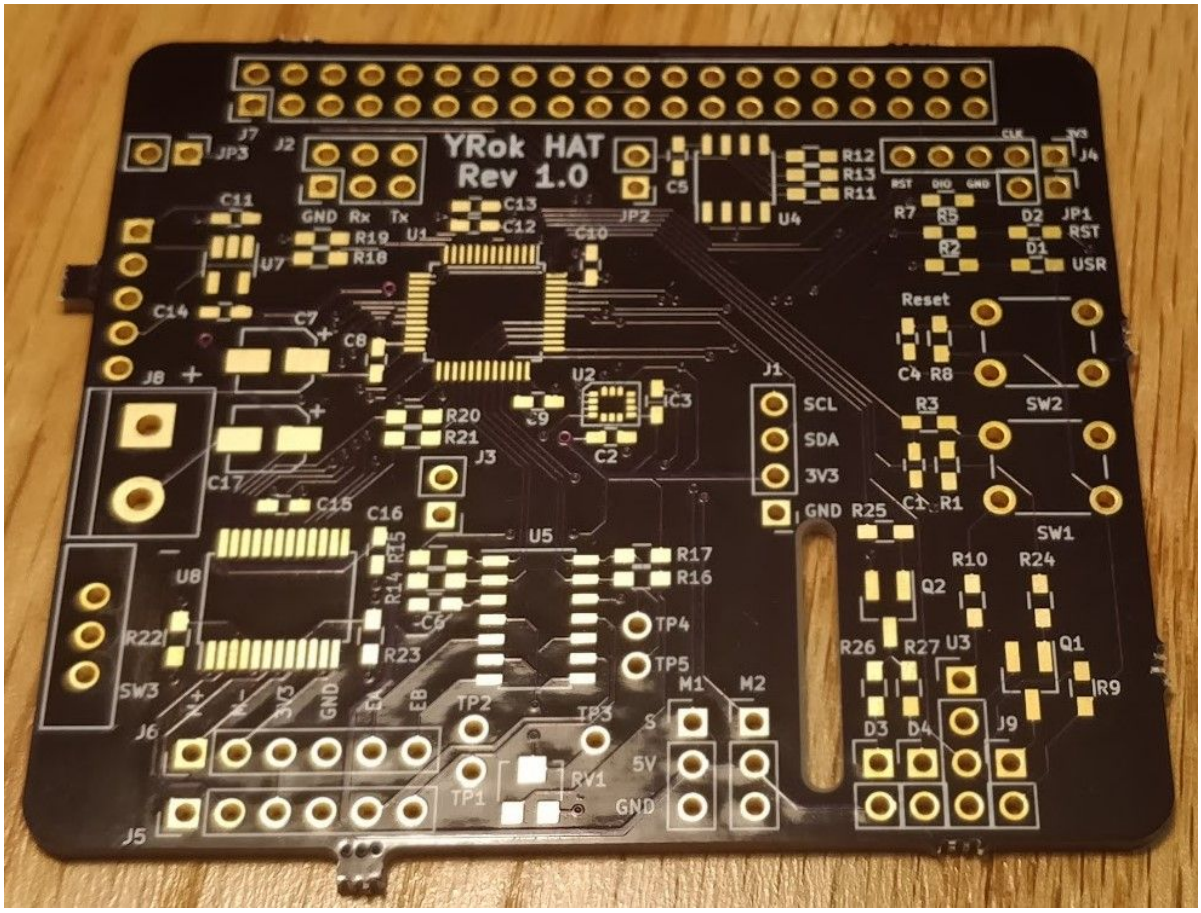
Implementation milestones:

1. PCB Design -- Sam
   Solder board/make stencil for surface mount ICs -- Sam
   Simple board test (blinking LEDs) -- Michael
   Design chassis - Sam
2. Communicate with IMU -- Jeremy
   Serial communication -- Jeremy and Michael
   Correctly control motors -- Michael
   Construct chassis -- wood or acrylic -- Sam
3. Design algorithm to keep balance -- All
4. Tune algorithm -- All
   Improve system reliability -- All

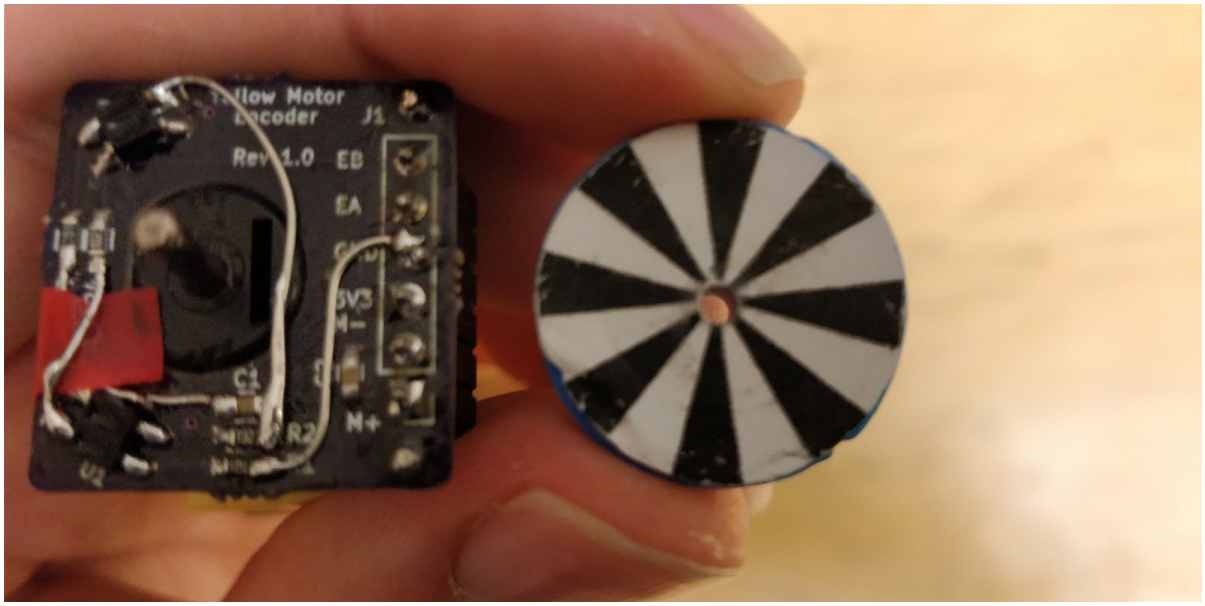
Functional block diagram:



★ Raspberry pi passively used for wireless programming



★ Custom microcontroller board (without components soldered on)



★ Custom encoder board, and 3D printed encoder wheel. The board has a minor error because the schematic component had incorrect pin numbering.