NYU Tandon School of Engineering

Embedded Challenge 2017

Objective: This project involves designing a controller to motivate a small vehicle through a meandering track without exiting track boundaries. Control of the vehicle is accomplished remotely and exclusively by hand/arm gestures. Teams will compete against each other in a single elimination competition.

Vehicle Details: The vehicle consists of an aluminum chassis with three wheels (one front center wheel, two rear wheels). Each rear wheel has a dedicated DC motor used to motivate each wheel independently. Both DC motors are connected to a PWM motor driver unit that controls the RPM of each motor independently based on a 2 PWM signals. The details of the PWM motor driver are included in the appendix.

Microcontroller Requirements: This project requires 2 microcontrollers.

Microcontroller 1: Atmel328P : This microcontroller will interface the PWM motor drivers on the vehicle and a wireless module to communicate to the other embedded microcontroller. The Wireless module used is the Nordic NRF24L01+ module (SPI). The specification for this wireless unit is included in the appendix. This microprocessor is powered by a 4 bank AA battery pack that plugs directly into the microcontroller Vin. The battery pack, vehicle, motor drivers and wireless module will be provided. You are required to provide the microcontroller and any other hardware, including wires.

Microcontroller 2: Atmel328P : This microcontroller will interface the sensor/s used to wirelessly instruct the vehicle. It may be powered by a 9V battery or any other suitable power supply. The same wireless module (NRF24L01+) is interfaced by this microcontroller to communicate wirelessly to the vehicle. Any number of sensors may be used, however, only sensors that communicate SPI, I2C, UART, or Analog signals may be used. Digital I/O (GPIO) may not be used. You must provide the sensors, microcontroller, power source and any other hardware required other than the wireless module.

Wireless Communications: You are permitted to use the NRF24 communications library (will be provided). However, you will be responsible for protocol design in terms of what messages result in what vehicle movements. There are no restrictions on the protocol design.

Sensor Details: As stated, any analog, SPI, UART, or I2C sensor may be used.

Track Details: The track will be approximately 30 feet long, varying width, with both left and right hand turns. Each team will start at one end of the track and continue to the other end. Two teams will race at time, but will start at opposite ends of the track.

Seeding Details: Each team will be provided 2 seeding rounds to run the track individually (no competitor) . The best time will be used to rank the teams from 1 to 18. After all teams are ranked, competition will begin with Rank 1 vs. Rank 18 followed by Rank 2 vs. Rank 17, etc in a single elimination fashion. This will continue until only 2 teams remain. The final competition will commence with the final 2 teams remaining.

Rules:

1. You may use well known register names, however you may not use any high level abstraction. Please see me if you have any questions about this.
2. Both teams competing will start simultaneously after a 3, 2, 1 countdown.
3. Each vehicle must start completely behind the starting line.
4. The time recorded for each team is marked after any part of the vehicle passes the first edge of the finish line.
5. If at any time any part of the vehicle passes any track boundary (inside edge) a 3 second penalty will be incurred (each time).
6. If a vehicle passes any track boundary (inside edge), the vehicle must return to inside of the track at that point. Any crossing of a track boundary with continuation in any other portion of the track will result in disqualification.
7. There may be no intentional ramming, disabling or interference with any other vehicle during competition. Any suspicious activity deemed intentional will result in disqualification.
8. Each team will have 2 seeding (ranking) opportunities. Total time will include any penalties incurred.

Grading:

This term project represents 40% of your final grade. The grading rubric for the project is as follows:

40% Performance (ranking/overall time)

15% Coding Efficiency

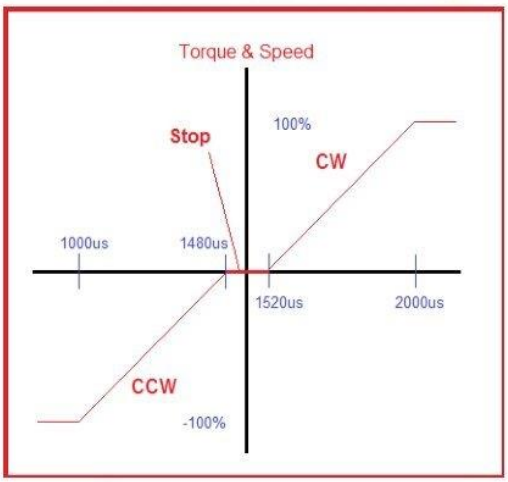
15% Repeatability/Consistency

10% Control smoothness

20% Cost efficiency

Motor Drivers Detail:

FT-SMC-2CH MAKES MOTORS INTO CONT. SERVOS



2CH Digital Motor Driver

the speed and direction control by PWM signal

The PWM control protocol

(

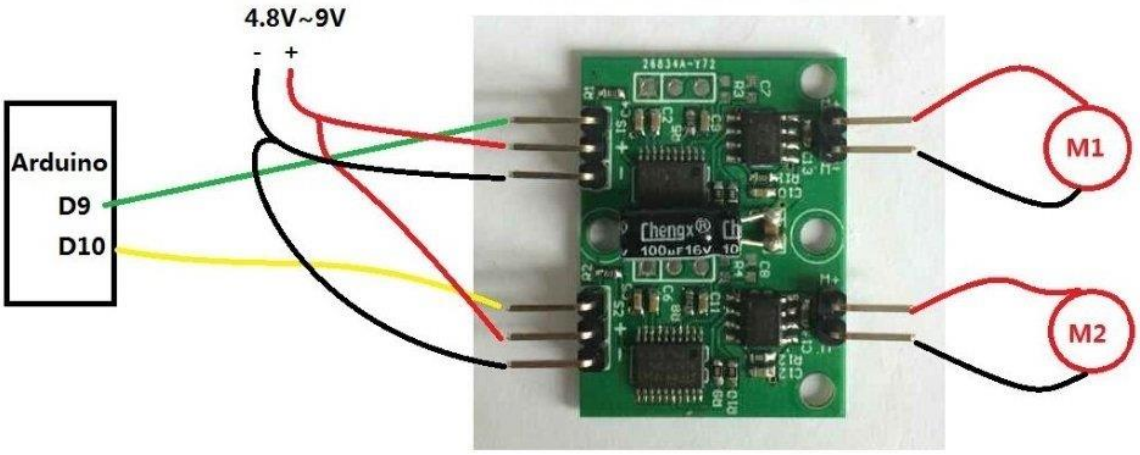
Stop deadband -- 1500us(+ - 50us) 50Hz

CCW -- 1450us(LOW speed) ~ 1000us(MAX speed)

CW -- 1550us(LOW speed) ~ 2000us (MAX speed)

)

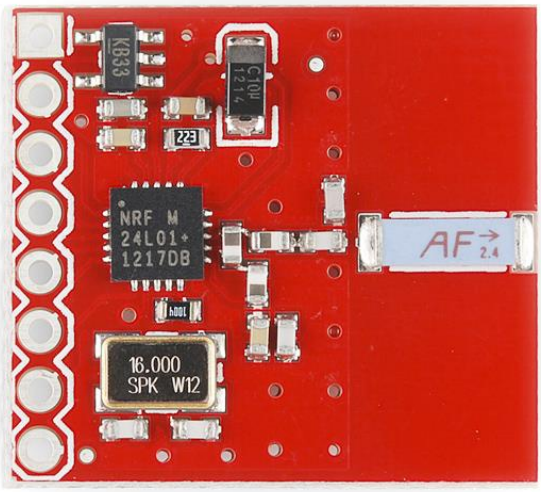
2CH- Motor driver controller

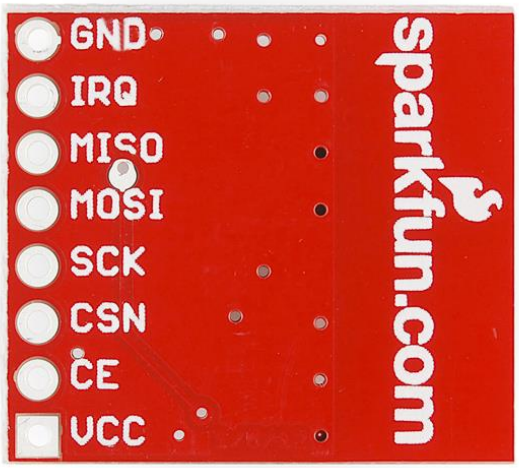


Wireless Module Data Sheet:

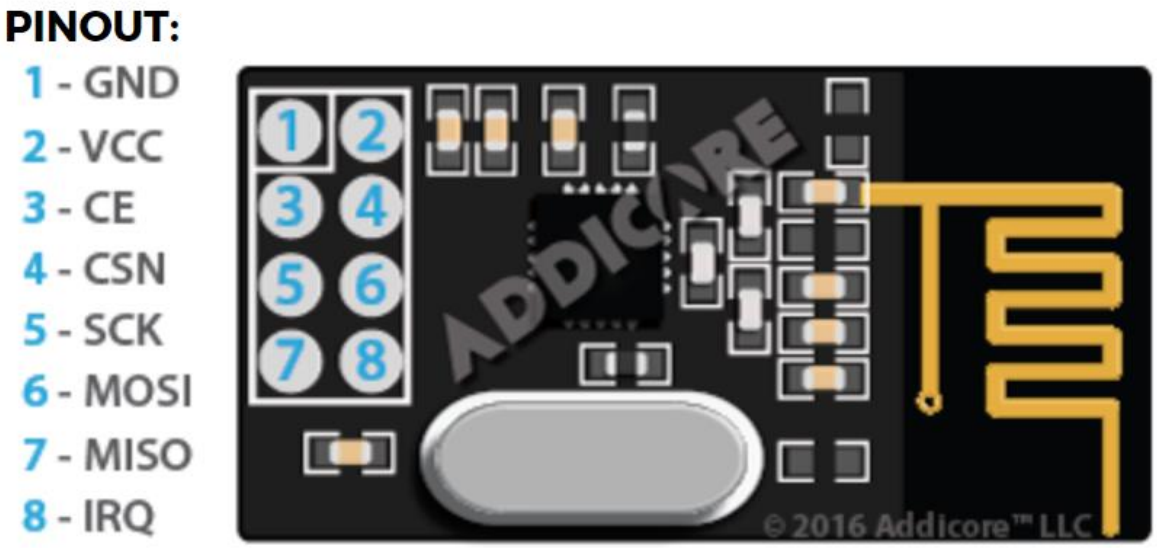
Visit: https://learn.sparkfun.com/tutorials/nrf24l01-transceiver-hookup-guide

There are two form factors (identical operation)





Or:



Library:

https://github.com/nRF24/RF24