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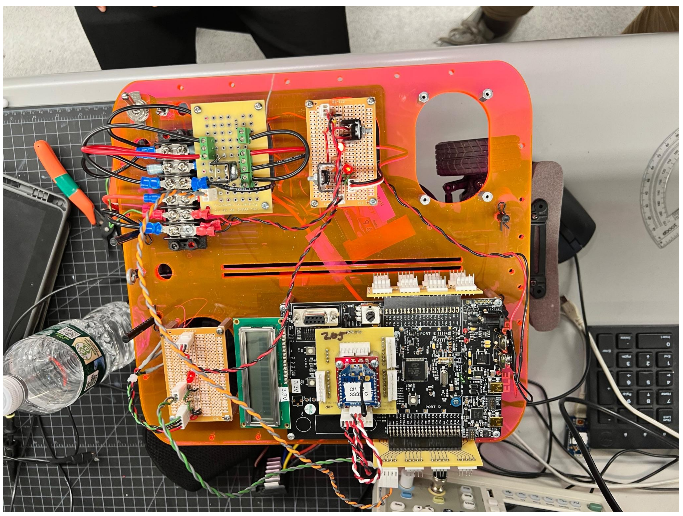
ECE 302
10/6/2023

Speed Control Lab Report

STATEMENT OF OBJECTIVE

The objective of this project was to design and build an autonomous car that can maintain a constant speed on both a flat surface, as well as up and down a ramp.

KEY SUB-SYSTEMS AND COMPONENTS



From the diagram above, the following are the key-subsystems used:

(1) Motor Board:

- PWM MOSFET: This is used for converting analog signals from the PSOC to digital signals to drive the motor. When the PWM signal from the PSOC is high, the voltage, VGS = +(logic signal is high), and this causes the MOSFET to allow current to pass through using electrons, because it's an n-channel MOSFET, to drive the motors. Otherwise when the logic signal is low, VGS = 0, then the MOSFET does not conduct and hence the motor is off.
- 100 ohms resistor: We need a small resistance at the gate terminal of the MOSFET so as to allow for higher switching time, because the base capacitor of the mOSFET gets charged quicker as well as prevent high power dissipation from our batteries.

- A diode: We connect a diode parallel to the motor so as to invert the digital signal from the PWM MOSFET as well as allow unidirectional movement of current. When the digital signal is high, then voltage flows across the path of least resistance, the diode path, leaving the motor OFF. When T. When the digital signal is low, then voltage flows across the motor and drives the motor. The diode also helps avoid any induced current back to the MOSFET.

(2) Power Board:

- Voltage regulator, 7805: This is a voltage regulator chip that helps output 5V no matter the input voltage. The output of this voltage regulator is fed into the
- Voltage regulator, 7806: This is a voltage regulator chip that helps output 6V no matter the input voltage. The output of this voltage regulator is fed into the
- LED: It is good practice to always have LEDs so as to ensure that the power board is being fed power and also enable easy troubleshooting when something isn't working.

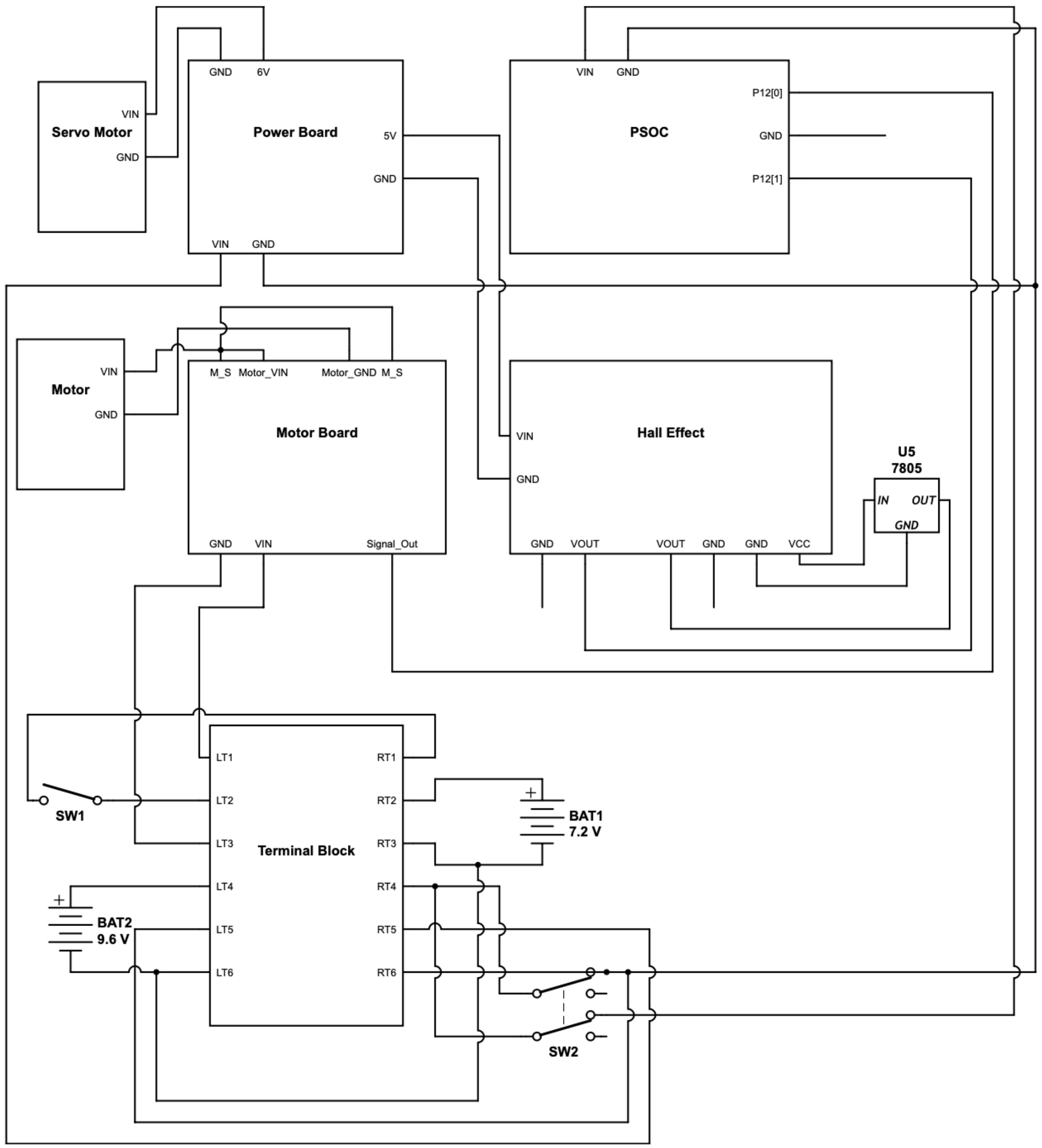
(3) Hall Effect Board:

- LED: It is good practice to always have LEDs so as to ensure that the power board is being fed power and also enable easy troubleshooting when something isn't working.
- Connection to a Hall Effect Sensor: The Hall Effect sensor, A110 which has 3 pins, gets connected to the Hall Effect Board. The purpose of the Hall Effect sensor is to fluctuate output voltage between hig(5V) and low(0V) under the influence of magnetic fields. Thus when the hall effect sensor sees a magnet, it switches to 0V, and 5V viceversa

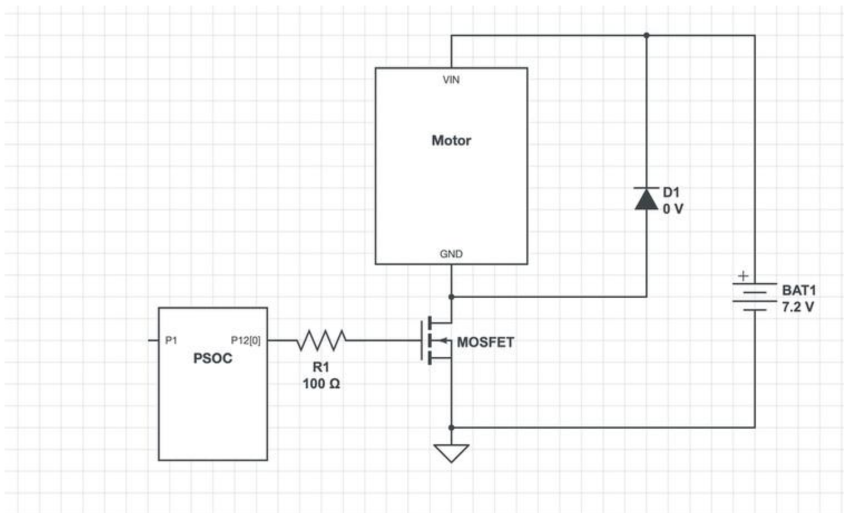
(4) PSOC(Programmable System on Chip)

- Programmed using a PSOC Creator
- XBee: Used for communication between the PSOC and the UART output, that is emitted into the computer.

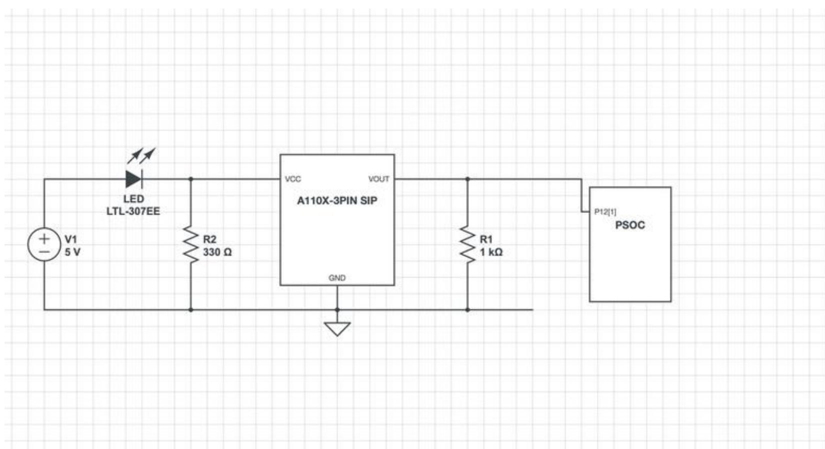
SCHEMATIC DIAGRAM OF CIRCUITS
OVERVIEW SCHEMATIC:



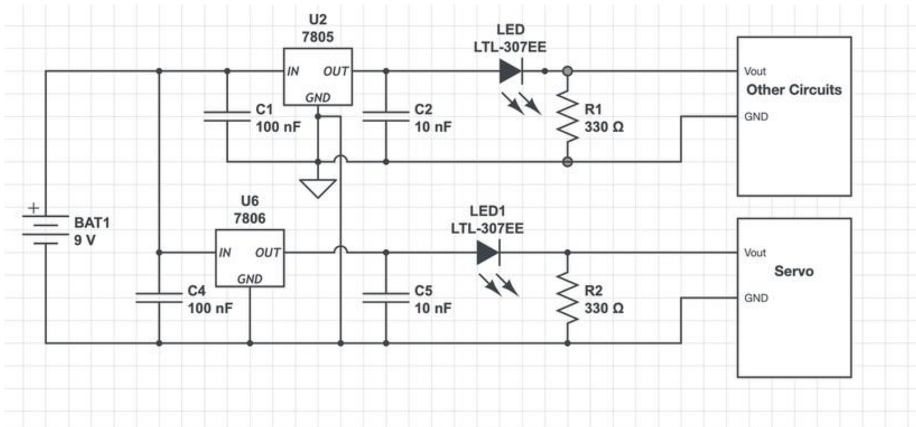
(1) Motor Board



(2) Hall Effect Board



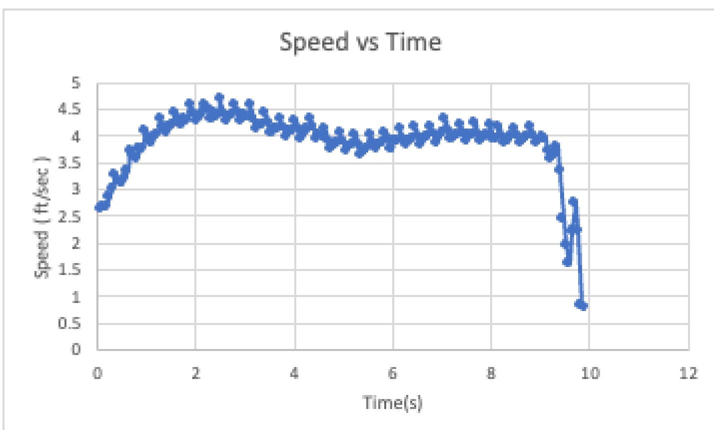
(3) Power Board



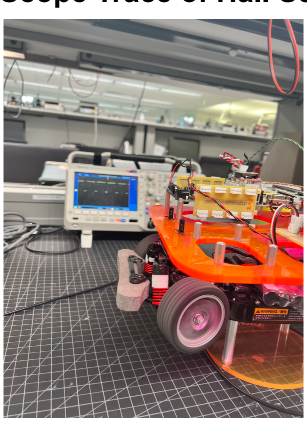
DATA:

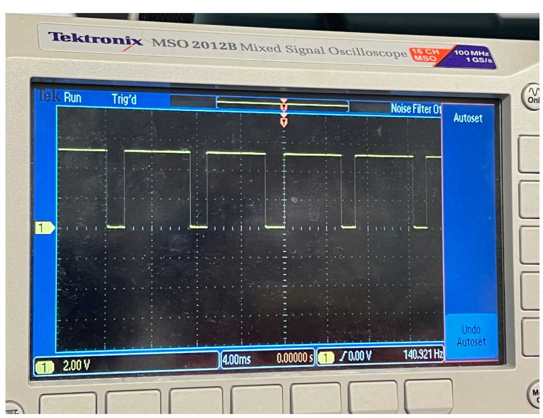
Telemetry Data

Graph indicating variation of speed vs time on a flat surface. Data extracted from PUTTy.

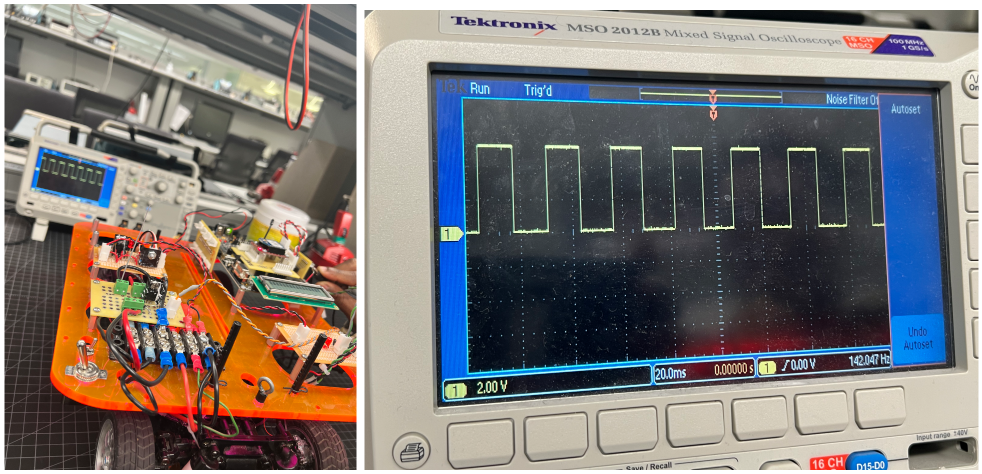


Scope Trace of Hall Sensor





PWM Signal



CHALLENGES & DESIGN CHOICES MADE

(1) Efficient placing of the Hall sensor was one of the biggest challenges we encountered. Oftentimes we realized that our Hall effect was too close and when the wheel of the car hit a disturbance on a ramp/flat surface the hall-effect sensor would be knocked out. Other times having the hall-effect sensor too far was also a problem we encountered and this came with a variety of problems such as getting bouncy signals on the oscilloscope indicating that the hall-effect wasn't getting measurements quite as accurate.

(2) Having LEDs at every board definitely helped us with troubleshooting whenever we had issues with our boards, because we could always cross out the problem of 'no power' when our LED turned on.

(3) PI Tuning was by far the most challenging aspect of this project. Our flat and up-data was pretty good as we could do both around 8s .However, going down the ramp proved to be very difficult as we would often play around Kp and Ki, often mismatching between the two and sometimes ruining our data for the 2 experiments. However, we were able to solve our problem by first getting almost close values for Kp and Ki for both flat and up-the-ramp, and then scaling the speed that we have by a certain number. By doing so, we were able to trick the car and help go down-the-ramp for the desired time.

WHAT COULD BE IMPROVED?

(1) Soldering our capacitors and placing them as close to the board as possible. This is the recommended way so as to avoid the resistance between the two legs of the capacitors

(2) The crossing wires between boards can be zip tied to the middle of the car so as to avoid any overhanging wires getting caught by anything from midair.

(3) Sticking to good color coding for the wires. RED/YELLOW = power, BLACK/GREEN = ground.

(4) Stripping wires much shorter, especially wires that are connected within a board because the shorter the wire, the lesser the resistance and this helps with saving energy and power from the batteries.

(5) Using the 470 ohms resistor as compared to the 330 ohms resistor, This is important because it helps avoid high energy consumption from the batteries.

Honor Code:
This represents our own work in accordance with University regulations.