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Project Final Report

Introduction:

(1) Problem description: With the society becoming more modern, more electrical equipment should be controlled automatically. Our project is to design and create a system which can let a little car to move along the wall. The wall should not be straight at all. The actual meaning of this project is that we can design a car which won't crash on the wall even if there is no one controls it. The main problem is how to let the car do go along the wall instead of going straight. Thus, our vehicle should have a monitor or a sensor, which can feel where the wall is, and should have a program or feedback chain to control the wheels' speed to let the car take turns.

(2) Design concept: We decided to use flex-sensor as the sensor to get the information that where the wall is. The way to know the wall and give the signal to vehicle is that when the flex-sensor touches the wall, its resistance will become larger as it bends; thus, we can use this to control the current across the sensor. What's more, we can control the car to take turns by only varying the current across one of the two motors. This is the basic design concept, and following steps are how to let the range of current varying be proper and easy to control. Another thing is we choose PWM method to control the motors' speed. This way has an important advantage that is, comparing with the way of dividing voltage, this way has a less waste of energy. According to these two reasons, we will

use the flex-sensors to control the pulses' widths. The PWM will control the motors' speed. These are the sensors and basic feedback loop in our design concept.

Analysis of Components:

(1) Characterization of each sensor:

2N5192 Transistors (2): its function is just as a switch, when there are current across its B-E port, the switch turns on; else, the switch turns off. It accepts the PWM signal and feedback to the motor drive sub circuit.

CD40106BE Inventor (2): we use it to form the pulses. It has another function, which is to turn over the duty cycle; however, we find that we do not need this function in our vehicle at all.

105 Capacities (2): we use it to build the PWM circuit.

Arduino (1): we use it as a power supply to the PWM sub circuit.

1N4148 Diodes (6): we use it to build the PWM circuit, and two of them are used to protect the motors.

Flex sensors (2): to get the information of if there is a wall on the way or not, and adjust the pulses' widths.

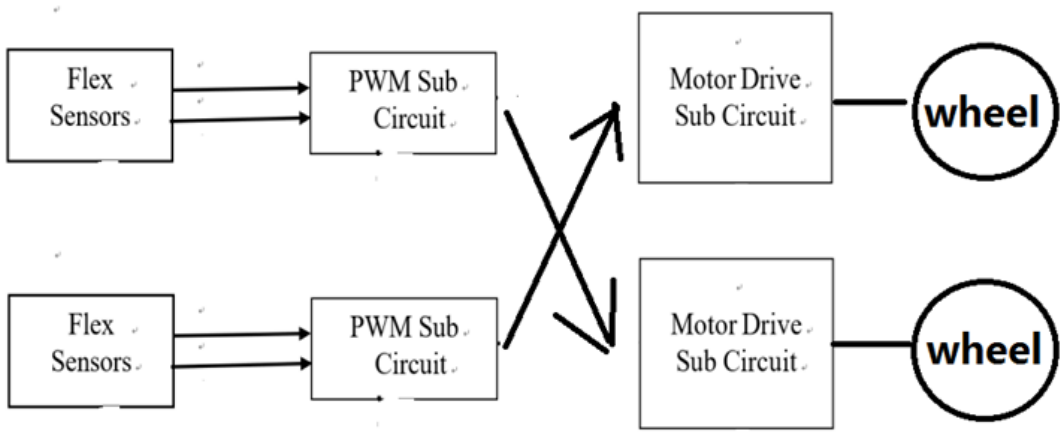
Resistors (about 10): to build the PWM circuit; to adjust the current in B-E ports; to adjust the current across the motors.

(2) Design Considerations: we have not used a variable resistor in the PWM circuit, because if we rotate it just a small angle, the resistance will change hundreds of Ohms; however, we just need several hundred Ohms there in total; thus, it does not make sense. The original function of the variable resistor is to remove the differences between the two motors(we know that the two motors cannot be extremely same), to approach this target,

we choose to add some resistors which have large resistance in parallel in one of the transistors' B port. Another change we have made is we have not used the transistor three times for each PWM, we just use it one time instead. Because the wave of the pulse performed really well, and the target of using it three times is to get a more stable wave; thus, we thought our wave performed well, use the transistor one time is enough, more components will just lead to be shorted.

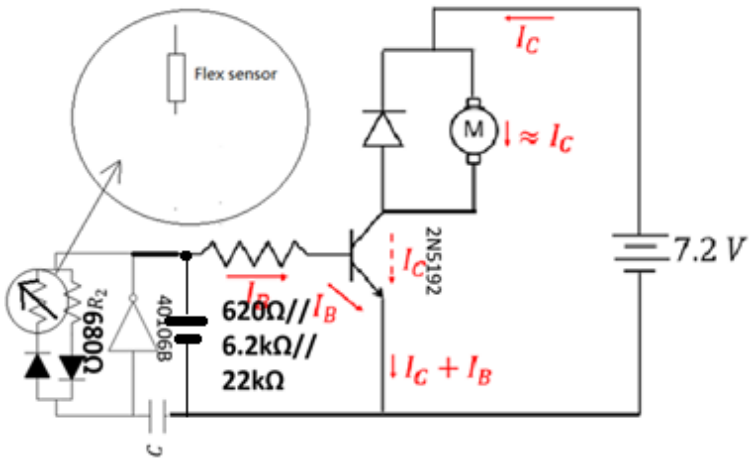
Design Description:

(1) Block Diagram:

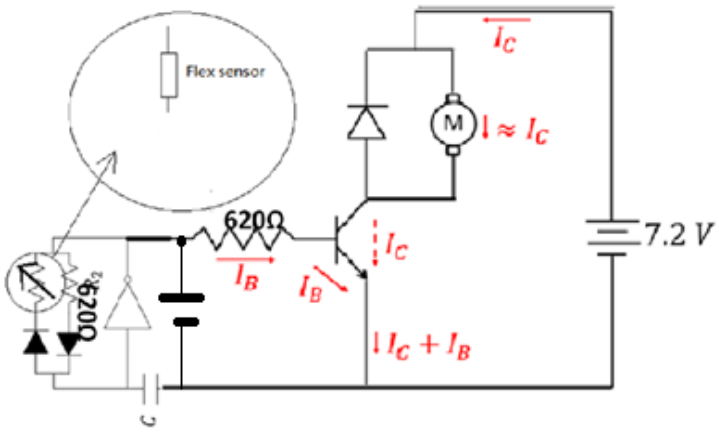


Flex-sensors get the information from the environment, and give feedback to the PWM Sub Circuit to produce/vary the waves with due duty circle. The PWM Sub Circuit pass the signal to the Motor Drive Sub Circuit, and the Motor Drive Sub Circuit will control the opposite wheel's speed.

(2) Circuit Schematics:



(Left wheel)

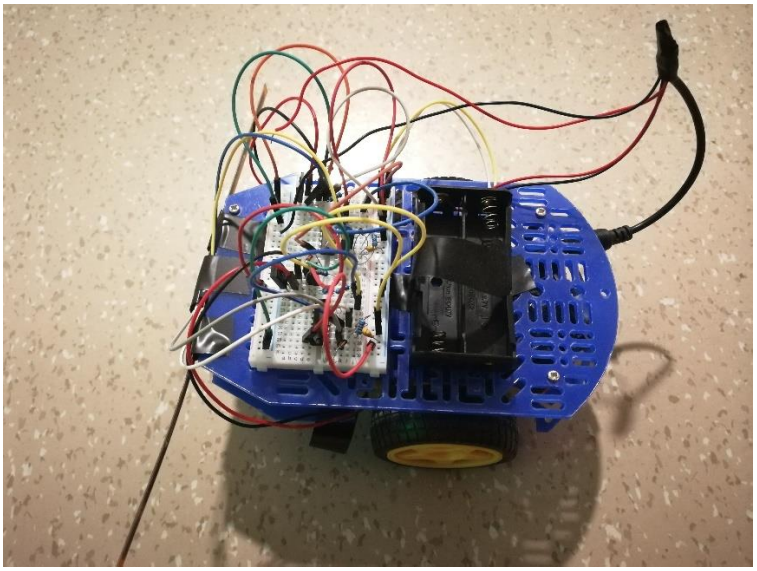


(Right wheel)

The Arduino acts a power supply in the PWM Sub Circuit. Left motor will run more slowly than the right one with the same voltage; thus, we add two resistors in parallel in the left system.

(3) Physical/mechanical construction: flex-sensors are mounted with stick bands in the front of the car; Arduino and Battery Panel are mounted by screw spike on the car (the car has two lawyers, Battery Panel is on the top lawyer, Arduino is on the bottom lawyer).

Other components are on the breadboard, and the breadboard is stuck on the top lawyer.



Conclusion:

(1) Lessons learned: we find that it's hard to mount the flex-sensors on the car; thus, we use some stick bands at last. Because there are too many bare wires in the circuit, we should learn to reduce wires as many as possible. We met some problems with the variable resistor as well, at last, we decided not to place it in our circuit anymore, and add some resistors in return. What's more, we find another way to slow down the car, not adjust the duty cycle, but add the value of the resistor's resistance, which is connected to the B port. We have learned to mount the car properly as well. What's more, we learned some tips on how to avoid being shorted.

(2) Self-assessment: Our car performed very well finally, although it runs too fast in the beginning, and cannot take turns properly in the process of the experiment. Totally, we did well in this experiment, and the car can take turns as the command. We did a good job especially in avoiding it being shorted. Maybe we can be more expertly next time, and do it faster.