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Technical Documentation for

WORLDWIDE FREESCALE CUP 2015

The following are the additions and changes/modifications that we implemented in the car:

1. Wheel Encoder
2. IR sensor
3. Additional Interface Board
4. Motor Driver Modifications
5. Servo Placement
6. List of components used in the car:

1. Wheel Encoder

To ensure that both the rear wheels are running at the same speed, an encoder was placed on each of the rear wheels as shown in Figure 1. This allows the speed to be measured and corrected accordingly.

Multi-pole magnet to allow for speed measurement.
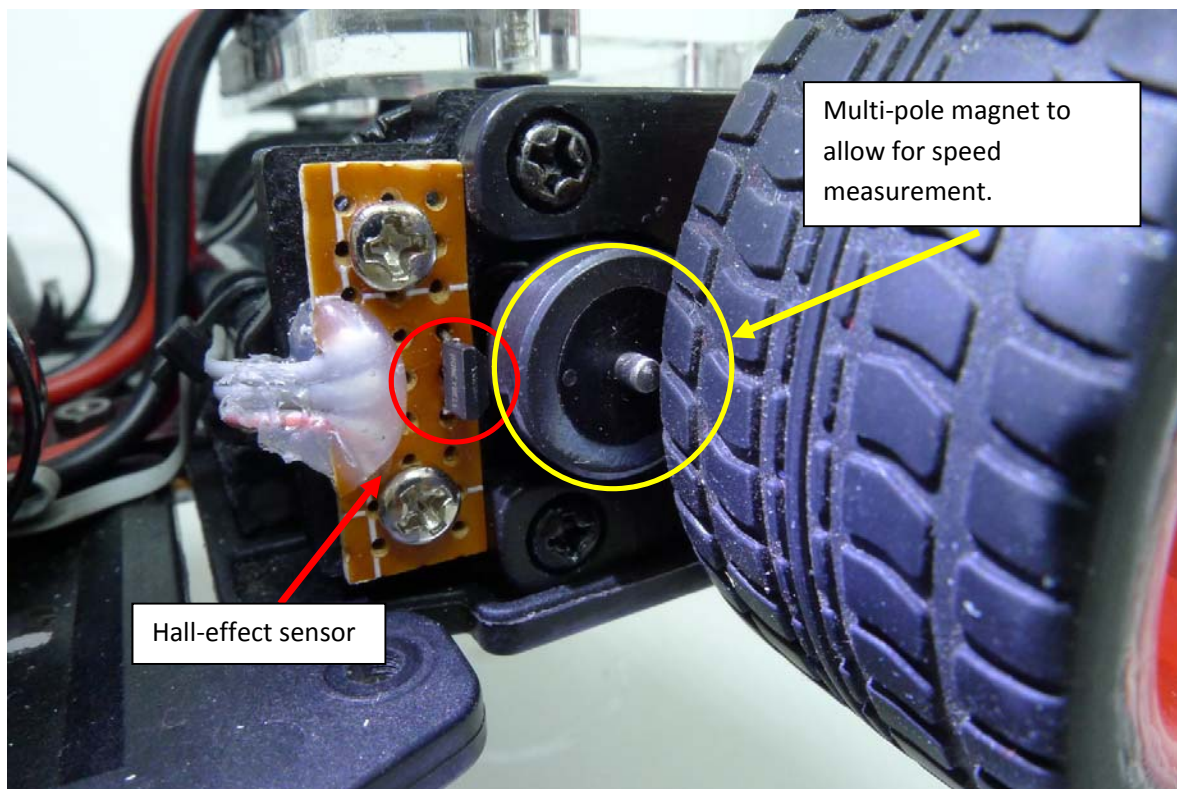
Hall-effect sensor

Figure 1

The encoder is also useful in synchronizing the wheel speeds during turns. Furthermore, use of the encoders allow for speed regulation upon detection of a ramp.

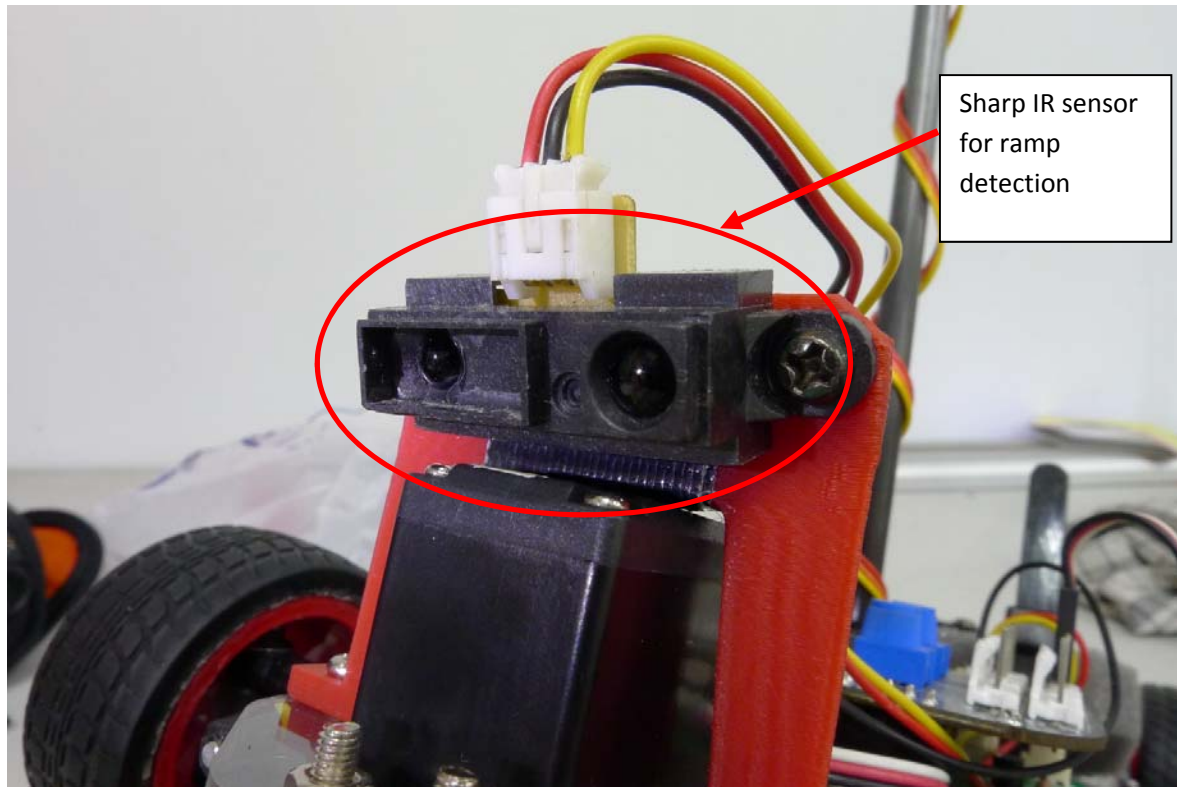## 2. IR sensor

Sharp IR sensor for ramp detection

Figure 2

An IR sensor is placed on the car and mounted as shown in Figure 2 above. The purpose of this sensor is to detect the presence of a ramp. By detecting the presence of a ramp in due time, the autonomous vehicle can be led by its control system to run at a constant speed up and down the ramp as opposed to accelerating up the ramp.

3. Additional Interface Board

The purpose of this Custom Board:
The custom board acts as an interface to route the signals from FRDM-K64F Freedom board to the FRDM-TFC Motor Driver board provided by the organizers. Necessary video signals and circuitry are also handled by this board. Schematics is available in Figure 5.
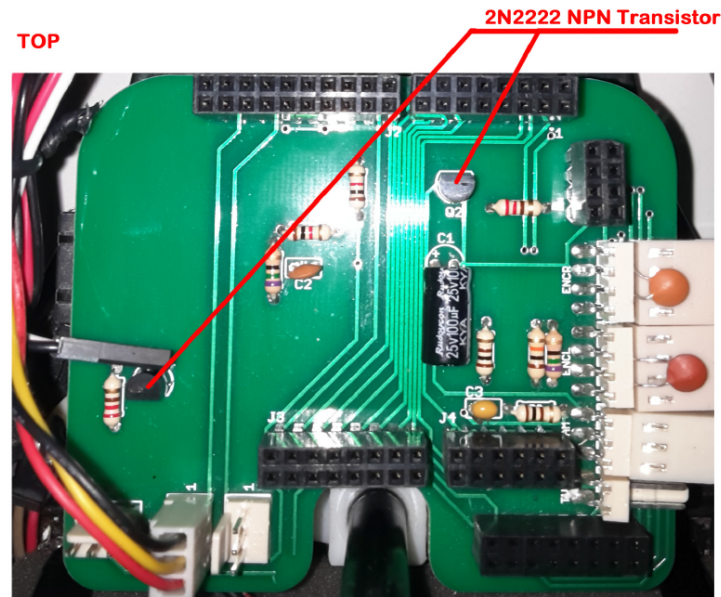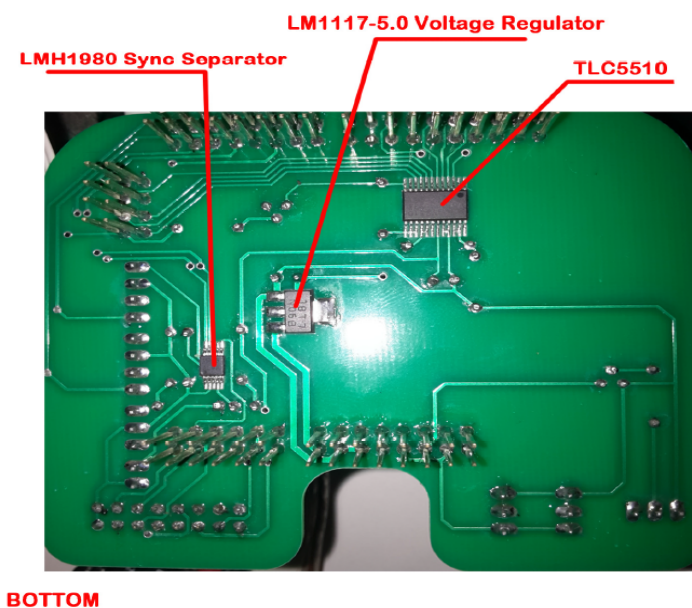

Figure 3

Figure 4

Qty	Value	Device	Package	Parts	Description
1	TLC5510	TLC5510	TSSOP-24	U$1	8-bit ANALOG-TO-DIGITAL CONVERTER
1	100nF	C-US025-025X050	C025-025X050	C3	CAPACITOR, American symbol
1	4.7nF	C-US025-025X050	C025-025X050	C2	CAPACITOR, American symbol
1	22-05-7028-02	22-05-7028-02	7395-02	J5	**CONNECTOR, R/A**
1	22-05-7038-03	22-05-7038-03	7395-03	CAM	**CONNECTOR, R/A**
2	22-05-7048-04	22-05-7048-04	7395-04	ENCL, ENCR	**CONNECTOR, R/A**
3	22-27-2031-03	22-27-2031-03	6410-03	AN1, AN2, EMG	**CONNECTOR, STRAIGHT**
1	LD117ASTR	LD117ASTR	SOT223	IC1	Low drop fixed and adjustable positive voltage regulators 1 A
2	2N3904	2N3904	TO92D	Q1, Q2	NPN TRANSISTOR
1		PINHD-2X10	2X10	J2	**PIN HEADER, LONG, FEMALE**
1		PINHD-2X4	2X04	RF	**PIN HEADER, SHORT, MALE**
1		PINHD-2X6	2X06	J4	**PIN HEADER, LONG, FEMALE**
2		PINHD-2X8	2X08	J1, J3	**PIN HEADER, LONG, FEMALE**
1		PINHD-2X8	2X08	DEBUG	**PIN HEADER, SHORT, FEMALE**
1	100uF	CPOL-USTT2D5	TT2D5	C1	POLARIZED CAPACITOR, American symbol
2	100R	R-US_0204/7	0204/7	R1, R3	RESISTOR, American symbol
1	10k	R-US_0204/7	0204/7	R4	RESISTOR, American symbol
2	1k	R-US_0204/7	0204/7	R7, R9	RESISTOR, American symbol
2	220R	R-US_0204/7	0204/7	R5, R6	RESISTOR, American symbol
2	75R	R-US_0204/7	0204/7	R2, R8	RESISTOR, American symbol
1	LMH1980	VSSOP-10		U$2	VIDEO SYNC SEPARATOR

Bill of Materials of the Interface Board

Figure 5

4. Motor Driver Modification

In order to reduce the load delivered by the MC33887 H-bridges and to reduce heat while running, extra MC33887 chips are connected in parallel with the existing chips. This modification is as shown in the images below (figure 6).
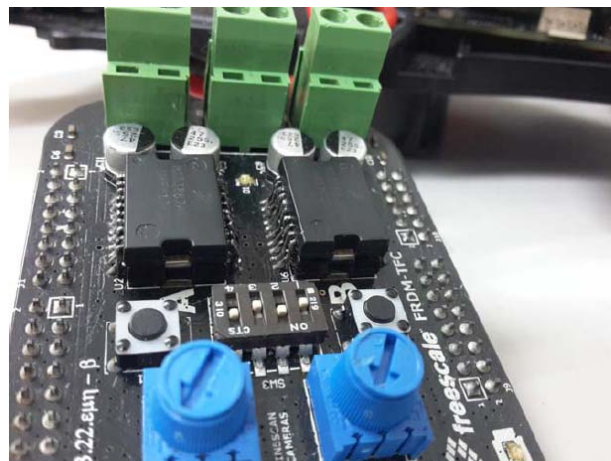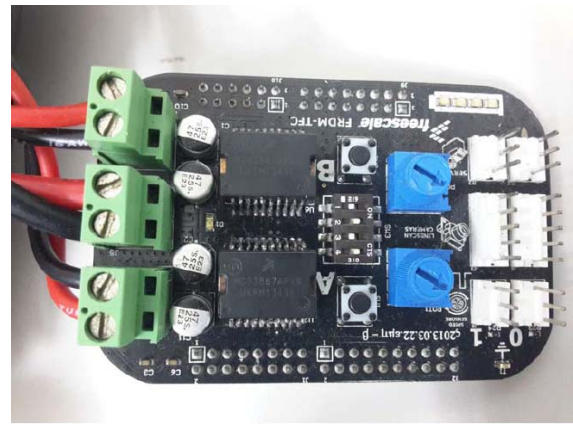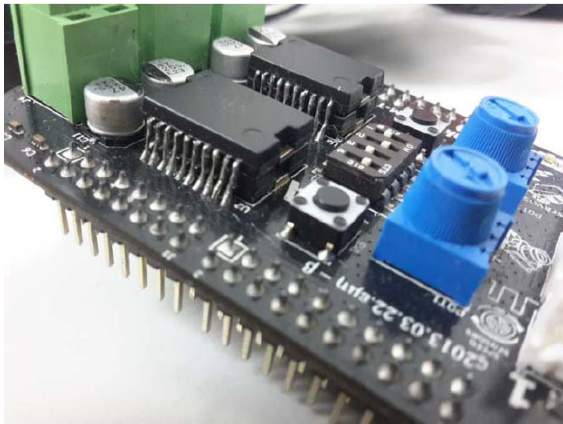

Figure 6

5. Servo placement

To ensure that the turning of the front wheels is balanced the servo was remounted as shown in figure 6 below. This helps not only in allowing unbiased turning, but enables the weight of the car to be distributed equally along the car as well.
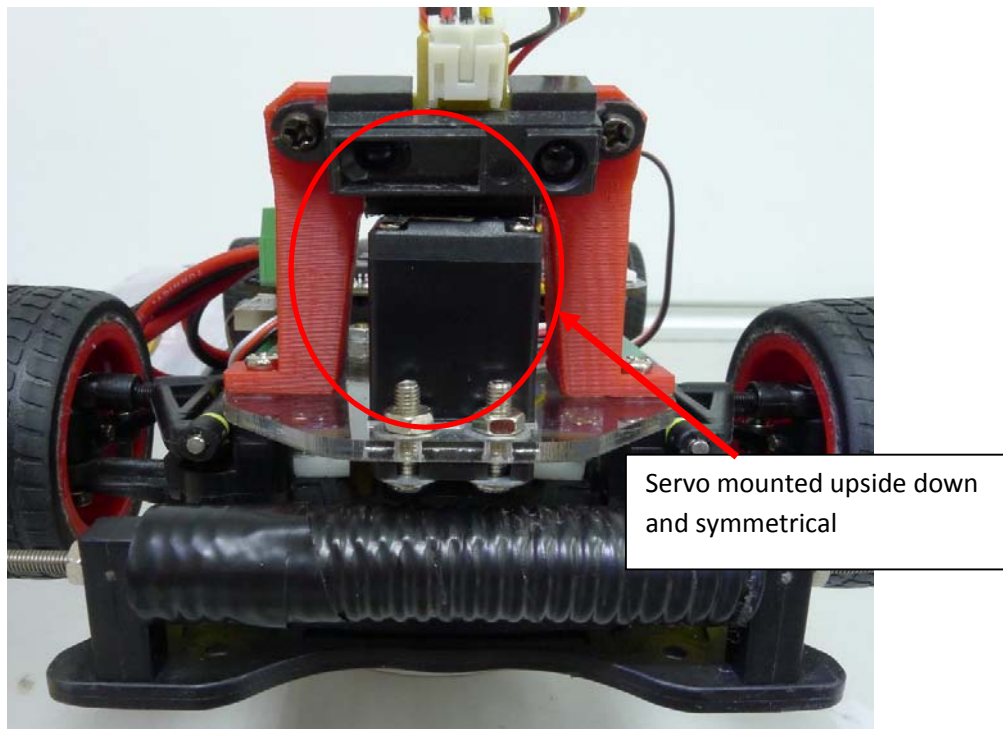

Servo mounted upside down and symmetrical

Figure 7

6. List of components used in the car

    a. Freescale FRDM-K64F Freedom Development Board
    b. OV5116 CMOS NTSC Camera
    c. Sharp 0A41SK IR Distance Sensor
    d. Custom Interface Board