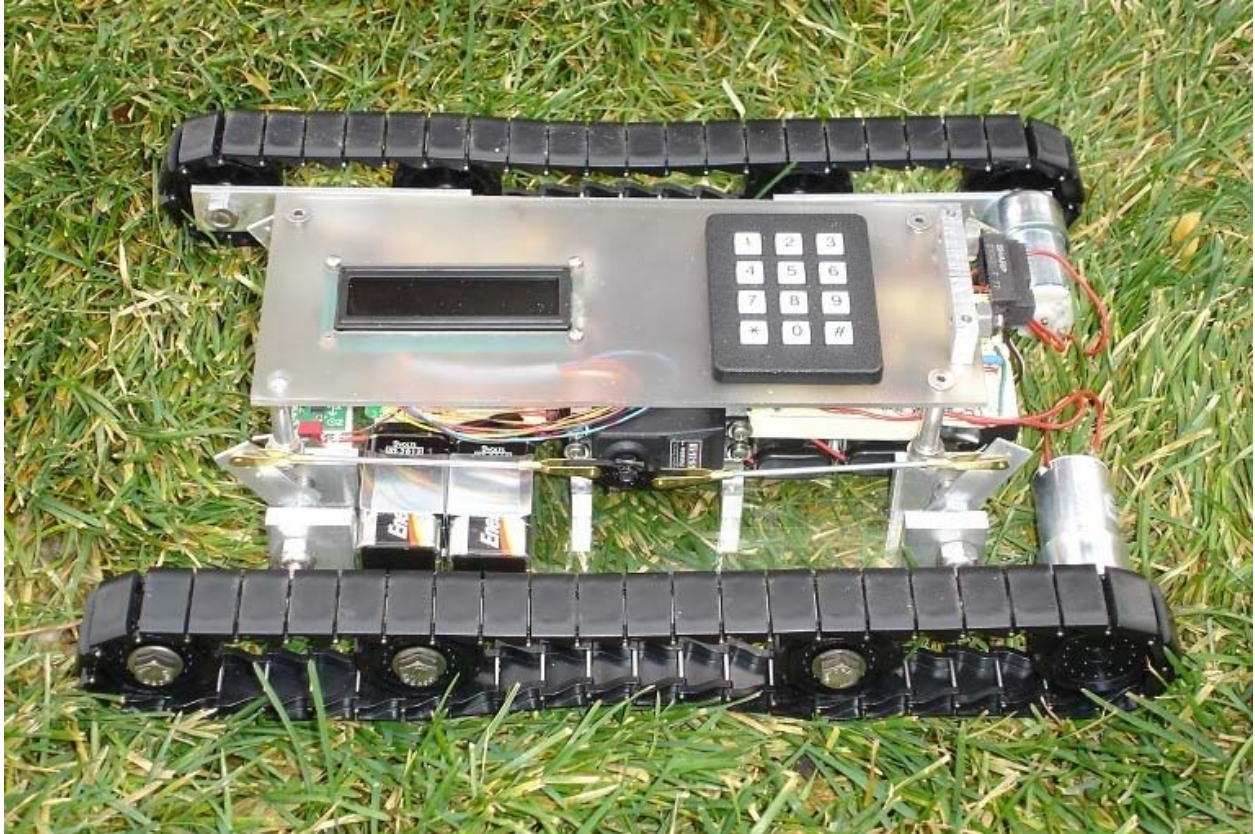


Versatile Robot

12/06/07



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Design Summary:

Our group designed and manufactured a miniature robotic vehicle that conquers various terrains. The vehicle was designed with a track system which is powered by two DC motors. The motors use a Quadruple half H-Driver in order to drive the motors in both directions. The track system incorporates a four bar linkage for each tread. These two linkages allow each side to be independently raised which gives the robot multiple configurations. These configurations allow the vehicle to drive on various terrains.

The robot is initially turned on with a simple switch. The LCD displays multiple mode options and gives directions for selecting a mode. Once the user selects the mode via the keypad they are then asked whether they want full speed, half speed, or stationary. Once selected the robot carries out the chosen mode and speed. While running, the LCD displays what current action the robot is carrying out.

During mode 1 the vehicle tracks remain flat and the proximity sensor becomes the main input. Once the sensor passes a certain threshold the robot reverses, turns, resumes forward motion at half speed via PWM for one second, and then continues on at full speed. Mode 2 will be the same as mode 1, but the tracks remain in the raised position. For mode 3 the tracks default position is raised but the accelerometer becomes another source of input. The accelerometer data is used to tell the robot's position relative to gravity. If the robot is climbing steep terrain the y output from the accelerometer will pass a determined threshold. Once this occurs the robot will reconfigure to flat configuration for lower center of gravity and maximum traction. If the robot is traversing along a slanted incline or object the x output from the accelerometer will pass a set threshold. Once this occurs one side will reconfigure to flat dependent on which side is tilted.

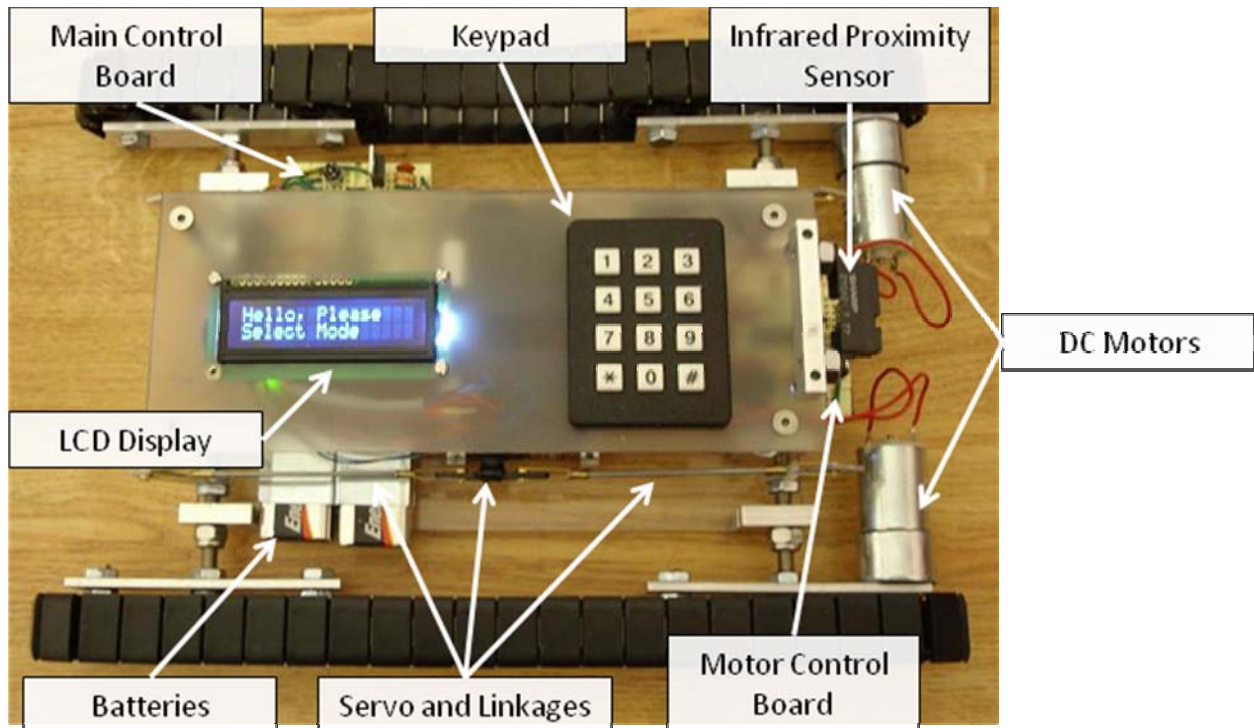


Figure 1: Components Top View

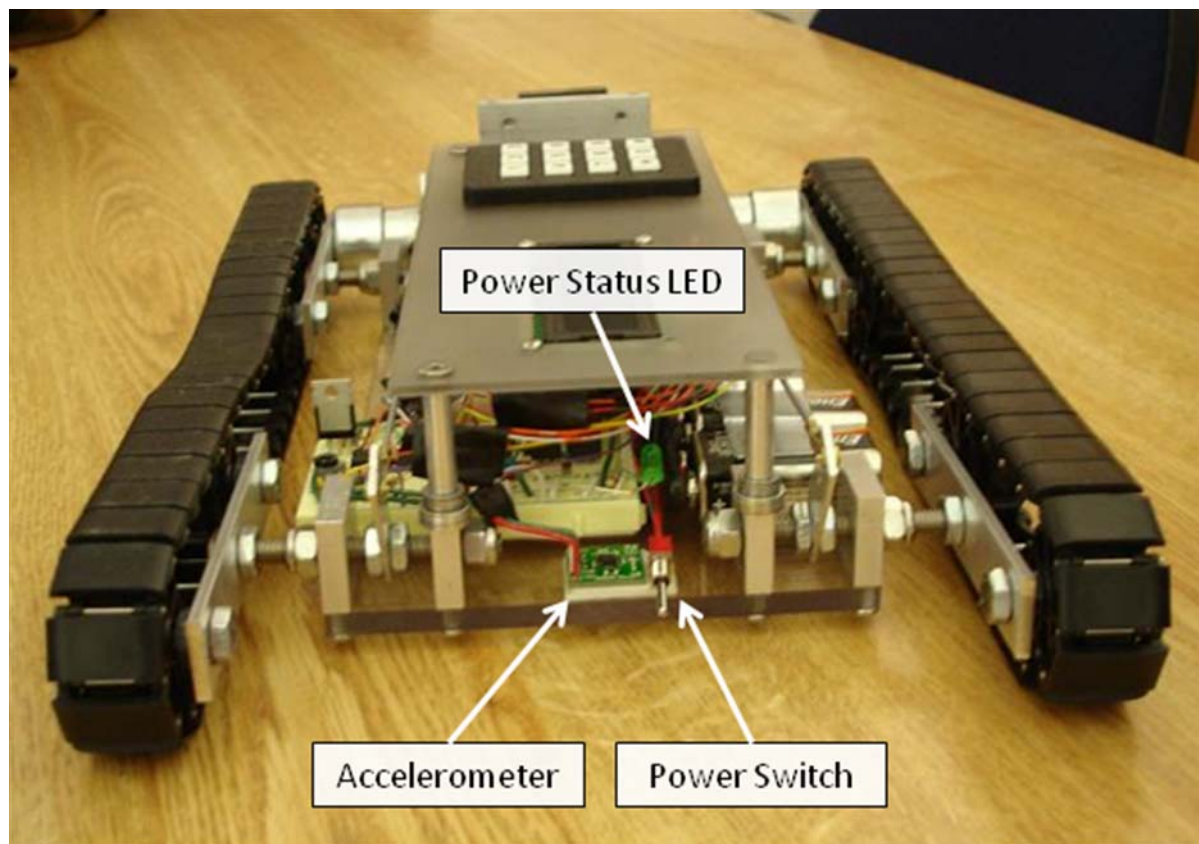


Figure 2: Components Rear View

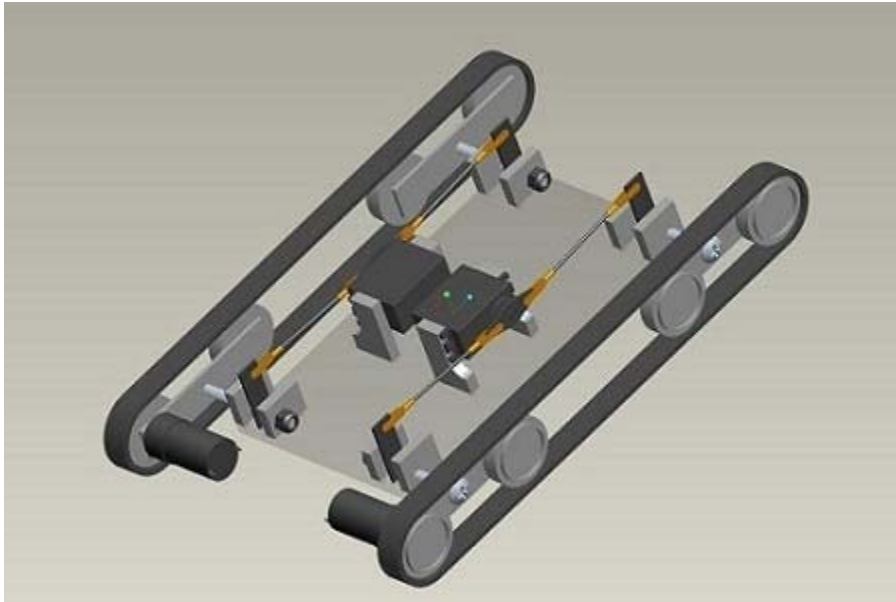


Figure 3: Flat Configuration

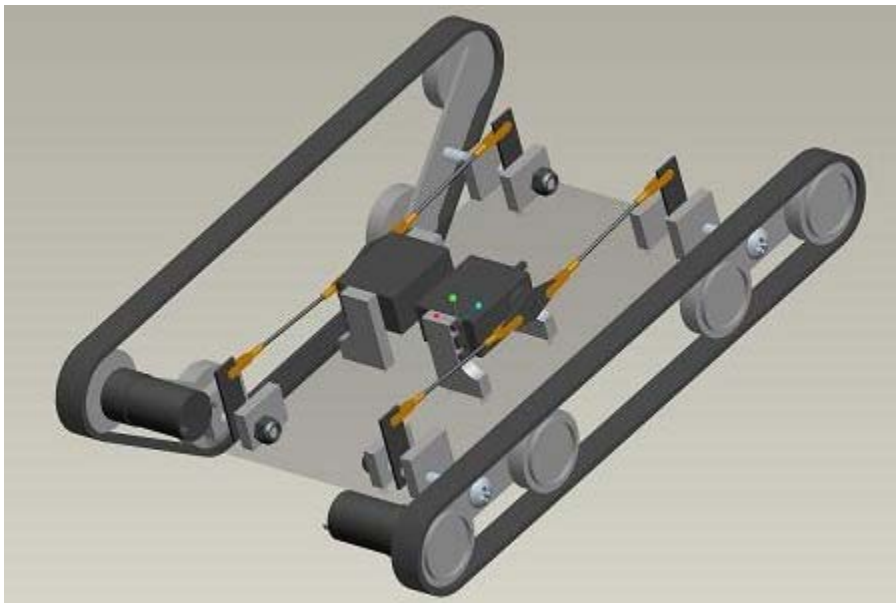


Figure 4: Left Tilt Configuration

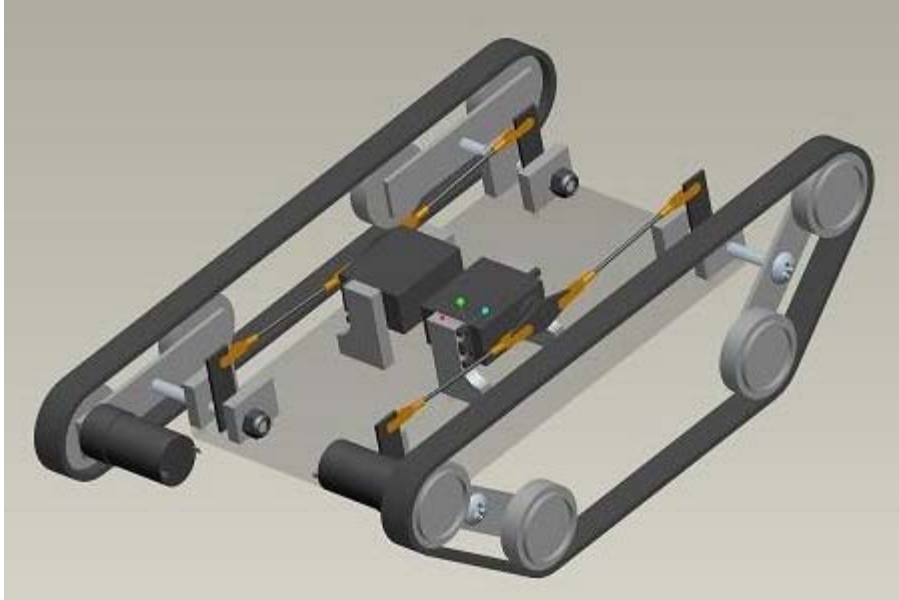


Figure 5: Right Tilt Configuration

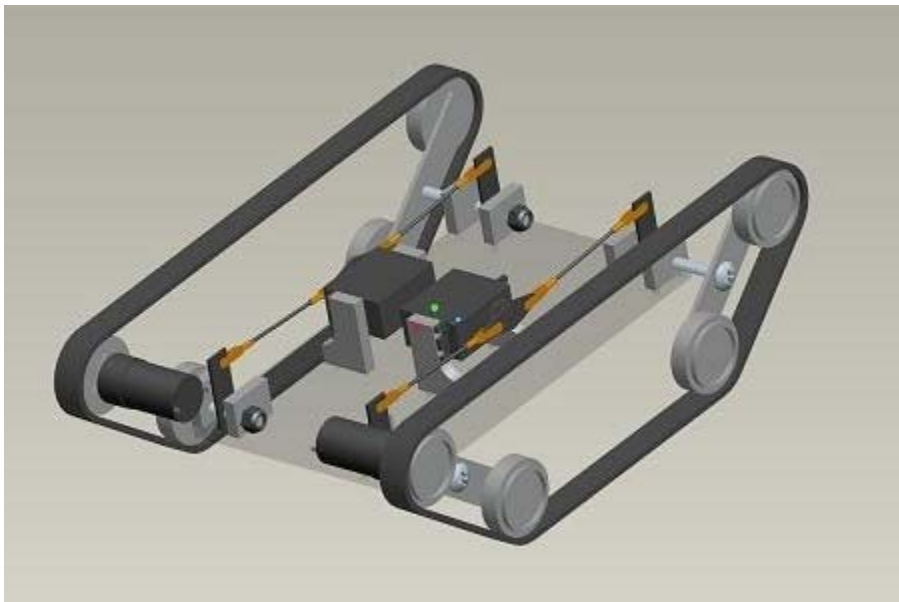
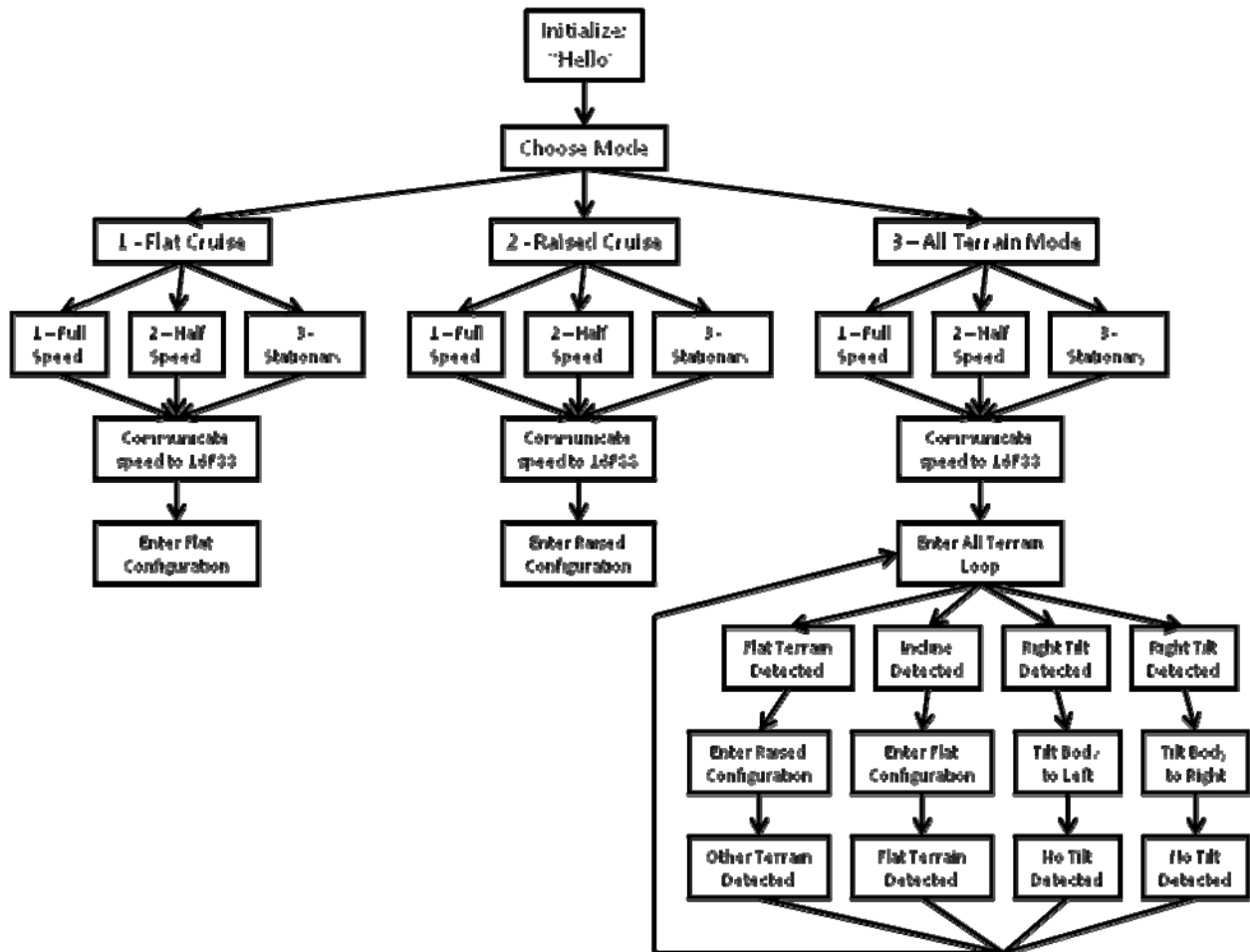
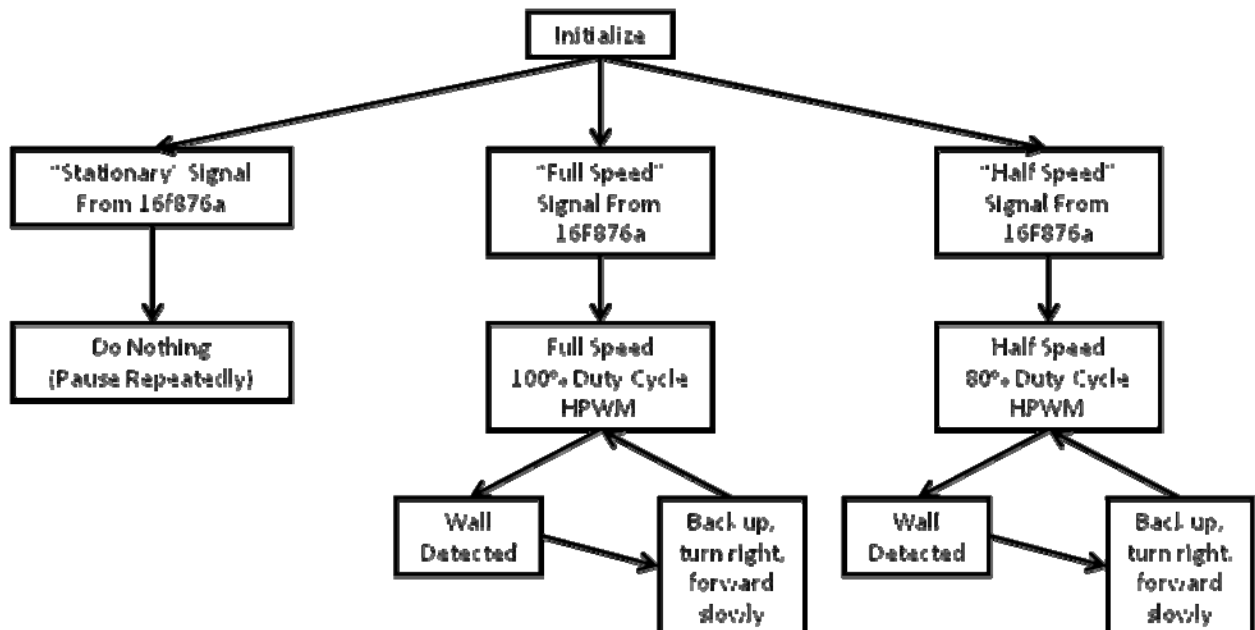


Figure 6: Raised Configuration

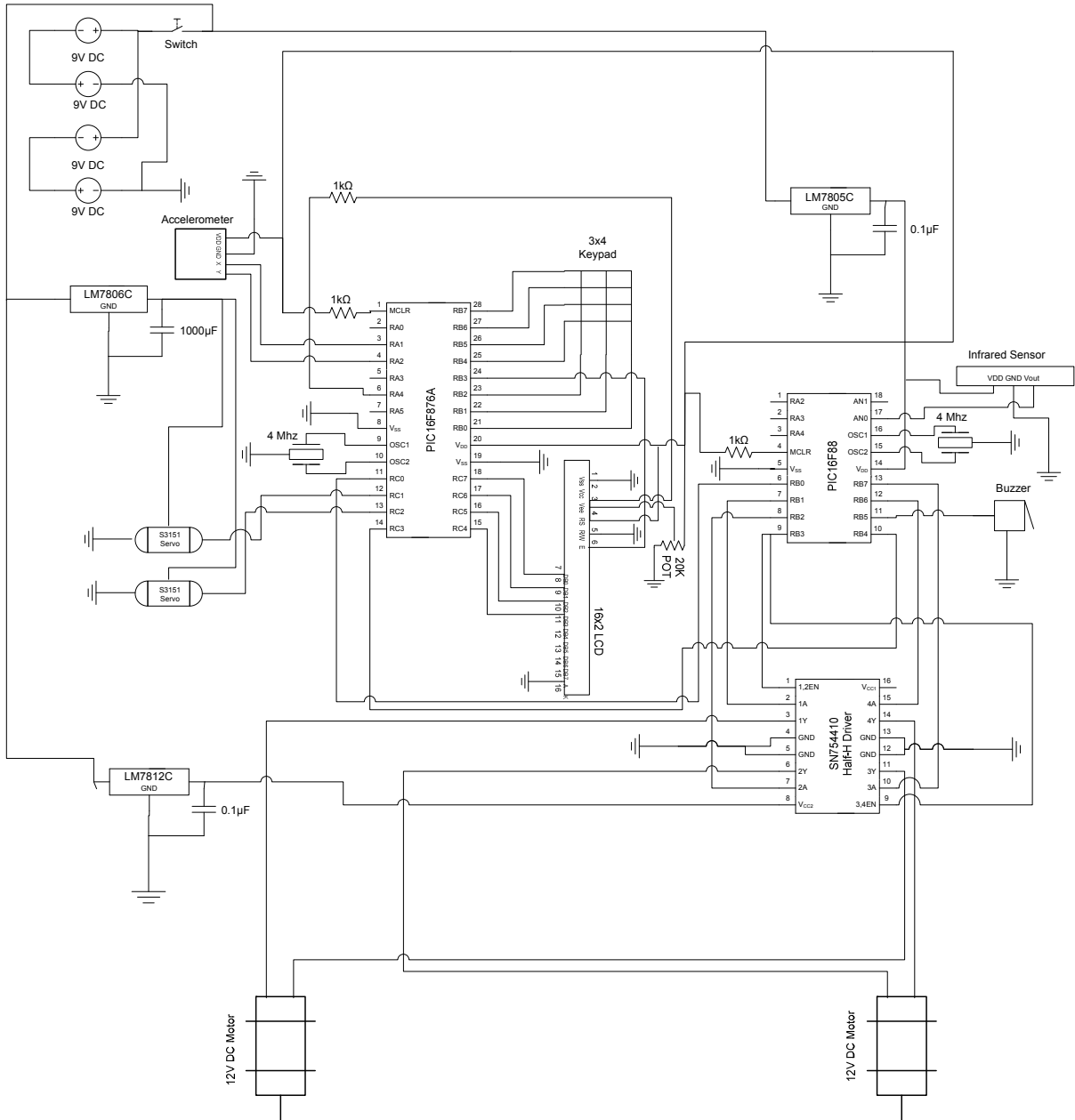
16F876A Flow Chart:



16F88 Flow Chart:



Circuit Schematic:



Design Evaluation:

The robot and all of its elements worked very well. Our output displays worked the way we needed them to. We have a simple LED that lights up when the robot power is on and the LCD displays our mode and speed menus exactly how we wanted it to. For our audio output device we used a buzzer. There is a very short buzz about once a second while the robot backs up. This is one element that we could have chosen to use something more difficult, but there were other elements that were far more crucial to the functionality of the robot that we chose to spend the extra time on.

Our three manual data inputs are a potentiometer, switch, and keypad, all of which work well. The switch turns the robot on and off, the potentiometer is used to control the contrast of the LCD, and the keypad is used to select the track configuration mode and motor speed.

We also used two automatic sensor inputs which were an accelerometer and an IR sensor. The accelerometer works great. When the robot is tilted past a certain point the servos will change the track configuration depending on which way the robot is tilted and then set them back to normal position once level again. The IR sensor works great, too. We used it to tell the robot when it is about one foot away from a wall or tall obstacle, at which time it stops, backs up for about a foot, turns right for 1.5 seconds or about 60-70 degrees, then proceeds to drive forward again.

The actuators we used were two servo motors and two PWM speed controlled and reversible DC motors. The servos control the linkage for the tracks and puts them at either 45 degrees or flat which is exactly what we wanted them to do. The two motors are for the robots drive train. We were able to get them to reverse and change speed just as we wanted. They also turn separate directions simultaneously, which we used to turn the robot.

For the logic, counting, integration, and control category we have a 16F88, motion in different directions and of different magnitudes, multiple PICs communicating in parallel, A/D conversion, and advanced PIC microcontrollers utilizing optional features. Our motion in different directions and magnitudes is the robot being able to turn and have different speeds, the multiple PICs in parallel take the analog data, convert it, and use the data to control the servos and DC motors, the A/D conversion is from our IR sensor and accelerometer, and the advanced PIC is the 16F876a used for the PWM control. Each one of our elements works correctly by itself and most work very well together for a fully functional robot.

Components List:

<u>Description</u>	<u>Vendor Name</u>	<u>Part #</u>	<u>Cost</u>
Tread Set for Futaba Servos (2)	Superdroid Robots	TD-028-030	\$59.90
16x2 Character LCD- White on Black	Sparkfun.com	LCD-00709	\$15.95
Polarized Connectors- Header 3 pin (2)	Sparkfun.com	PRT-08232	\$0.90
Scrap Polycarbonate- 1.5 lbs	Ft. Collins Plastics	-	\$2.98
1k ohm - 1/4 W resistors	Radio Shack	271-1321	\$0.99
Hardware (assorted)	Ace Hardware	-	\$30.00
Aluminum Stock	Ace Hardware	-	\$15.00
5V Voltage Regulator	Mountain States	NTE960	\$1.87
12V Voltage Regulator	Mountain States	NTE966	\$1.87
0.1 micro F Capacitor	Radio Shack	272-135	\$0.99
1000 micro F Capacitor	Radio Shack	272-1047	\$2.59
12V Reversible DC Motors (2)	Sparkfun.com	ROB-00424	\$31.90
Buzzer	Radio Shack	273-074	\$3.49
Keypad	allelectronics.com	KP-22	\$7.50
Switch	Radio Shack	275-645	\$1.49
Futaba Digital Servo S3151 (2)	towerhobbies.com	LM0054	\$51.47
Linkages	Hobby Town USA	-	\$13.53
16F876A	microchip.com	PIC16F876A-I/SP	\$0.00
16F88	microchip.com	PIC16F88-I/SP	\$0.00
Small Breadboards	Radio Shack	276WBU301	\$16.00
Accelerometer	Sparkfun.com	SEN-00849	\$29.95
Proximity Sensor	Sparkfun.com	SEN-00242	\$12.95

Micro-Size Potentiometer	Radio Shack	271-280	\$1.49
Green LED	Radio Shack	276-022	\$1.49
Wire	Matt's House	-	\$0.00
9V Batteries	Sam's Club	705821	\$16.86
6V Voltage Regulator	Mountain States	NTE962	\$1.87
H Bridge	Sparkfun.com	SN754410	\$2.35
4 MHz Oscillator (2)	Sparkfun.com	COM-00543	\$3.00
Servo Plugs	Hobby Town USA	EXRA220	\$2.75
9V Snap Connectors (5)	Radio Shack	270-324	\$2.69
		Total=	\$333.82