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**MSP430 TANK**

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# MOTIVATION

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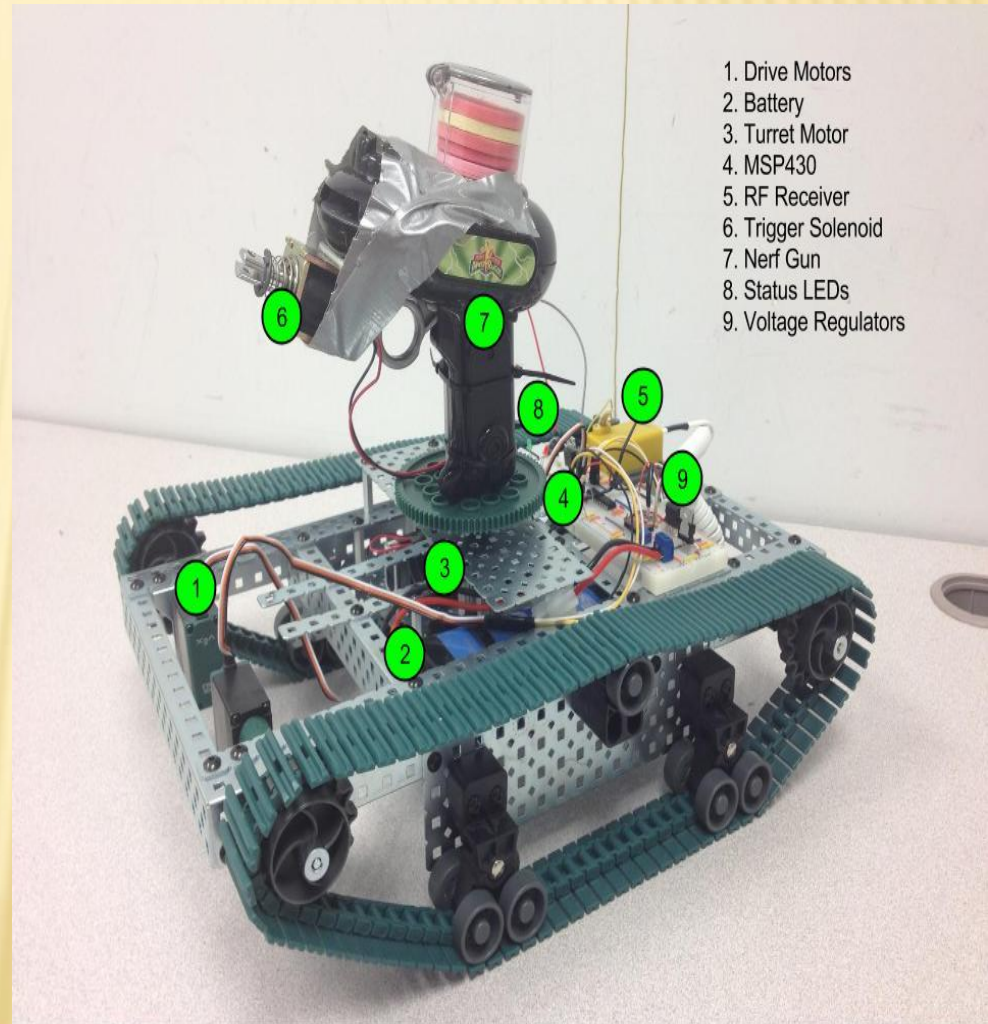
Goal was to make an interactive toy while learning to use the MSP430 microprocessor.

We decided to create a tank!

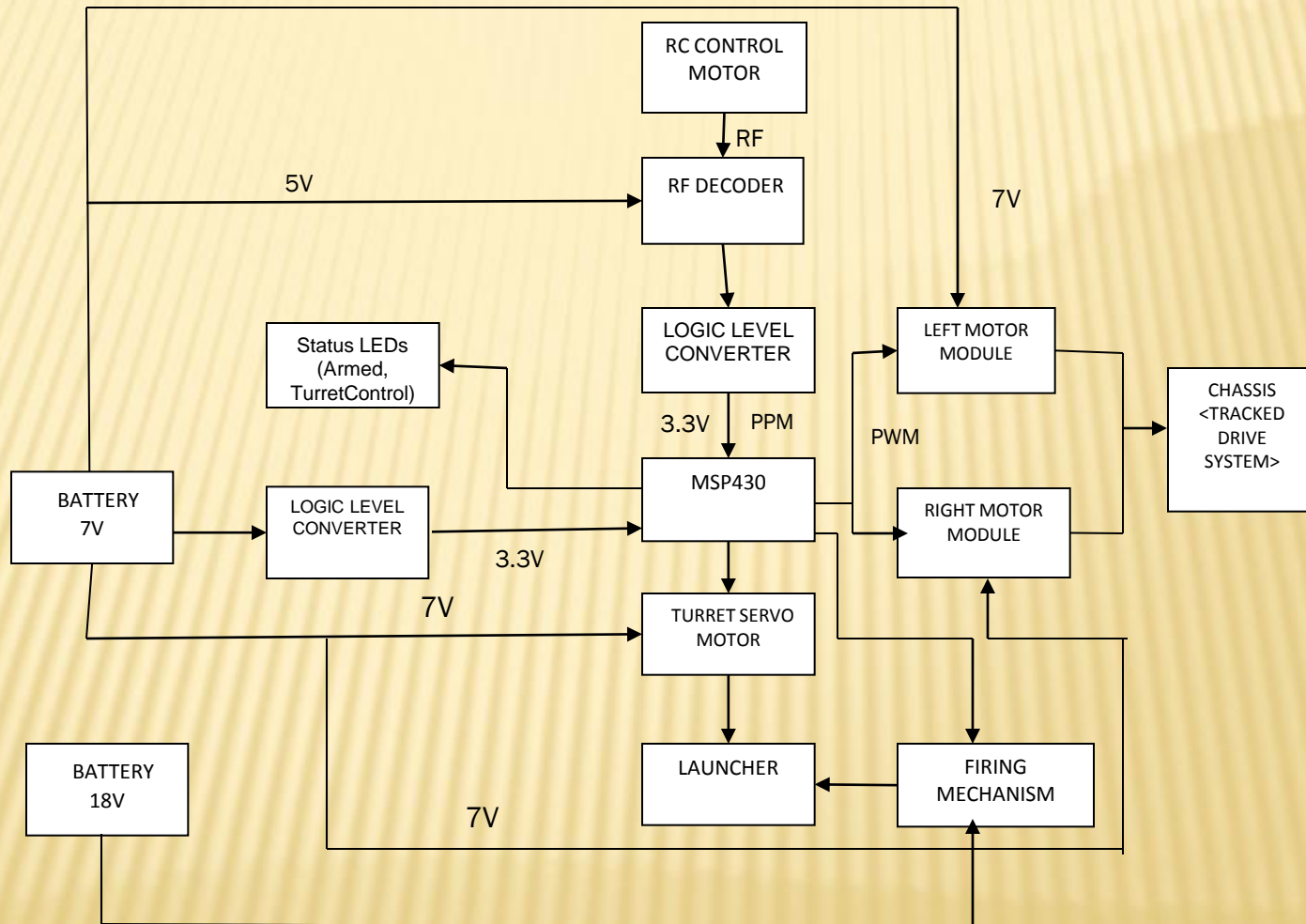
- + Remote control for interactivity.
- + Tread and drive motors as every tank needs.
- + Nerf-like weapon for real shooting action!
- + Turret control for shooting flexibility.
- + Status lights for user feedback.

# OVERVIEW

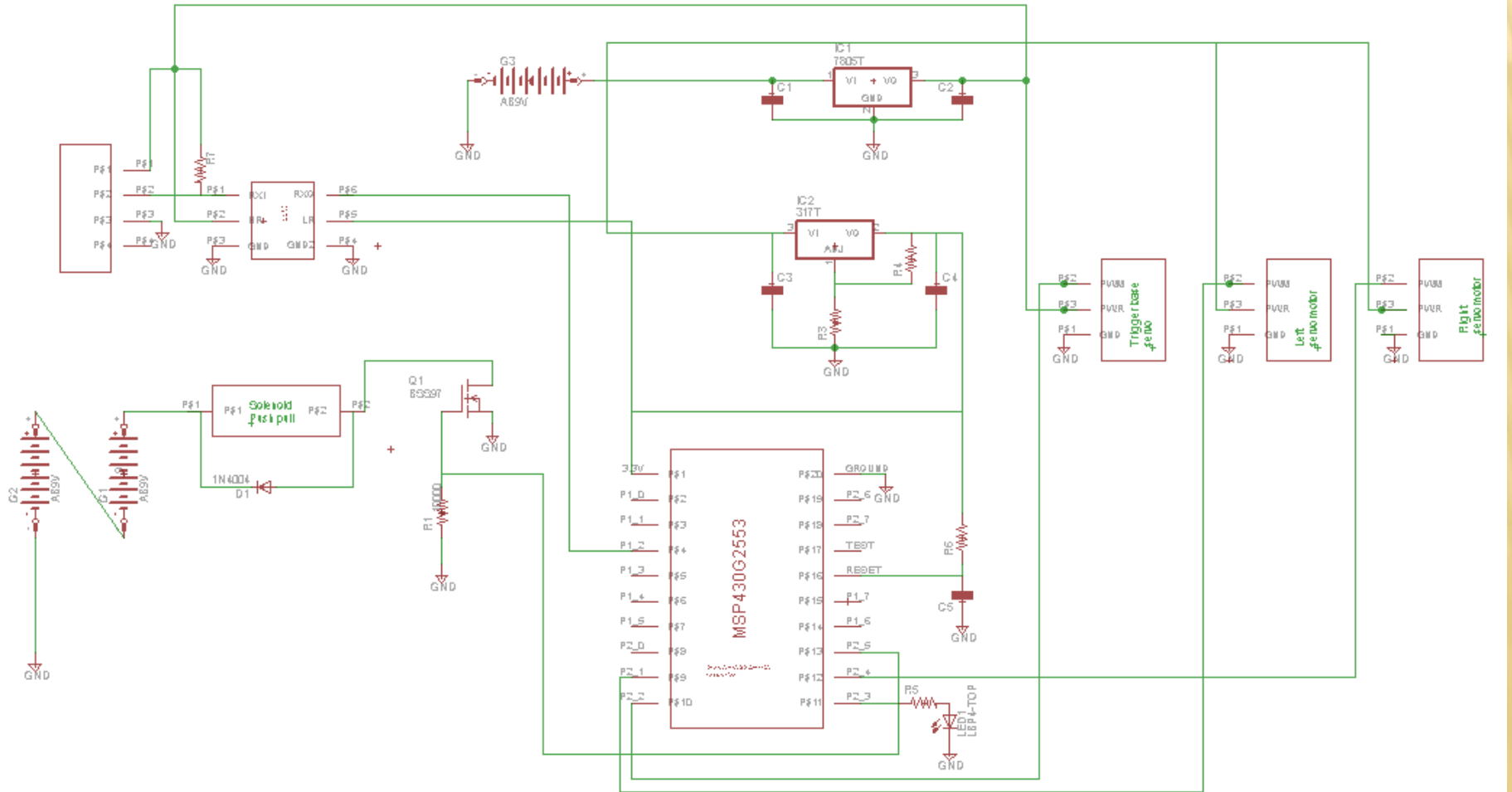
- ✘ The system is operated by the MSP430.
- ✘ System is built on the Vex metal frame, i.e. the chassis.
- ✘ RF controlled receiver/transmitter to control the movement of the motors.
- ✘ There are two drive motors used for the movement of the left and right part of the chassis.
- ✘ One servo motor which is used for the movement of the gun.
- ✘ The gun is triggered using a solenoid.
- ✘ A red and green LED serve as status lights for “Armed” and “TurretControl” states.



# BLOCK DIAGRAM



# SCHEMATIC



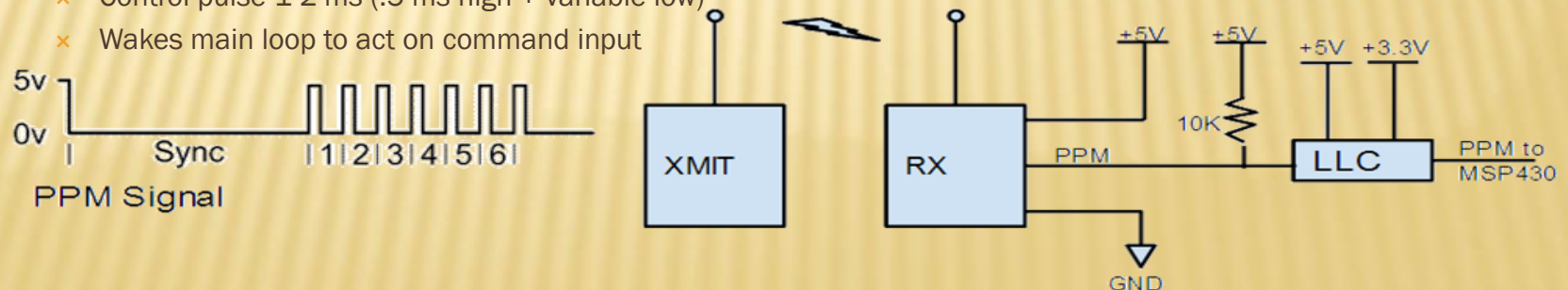
# RF CONTROLLER

## ✘ Hardware interface

- + Vex 6 Channel RF Transmitter/Receiver using Pulse Position Modulation (PPM)
- + 4 Pin RJ-10 to breakout cable to breadboard
  - ✘ 5V, GND, PPM Signal, NC
- + Will use MSP430 Pin 4: TA0.1 for PPM input
- + Pull up resistor required for PPM output
- + Logic Level Converter to step down 5V output for PPM

## ✘ Software Interface

- + PPM Signal will be connected to Timer\_A0 capture channel 1
  - ✘ Measure time between rising edges
  - ✘ SMCLK gives 1us resolution
  - ✘ “Up” mode to allow PWM output on TA0.2
- + Requires TA0.1 interrupt vector
  - ✘ Sync time ~9 ms, resets control sequence
  - ✘ Control pulse 1-2 ms (.5 ms high + variable low)
  - ✘ Wakes main loop to act on command input



# DRIVE MOTORS AND TURRET MOTORS

- The drive motors are used for the movement of the left and right part of the chassis. The turret motor which is used for the movement of the gun.

- **Hardware Interface:**

- 3-Wire Servo Motors

- Power: 7V
    - Control: PWM Signal range 1-2ms.
      - 1.5ms pulse corresponds to neutral/stop
    - Ground: Connected to vehicle power system

- **Software Interface:**

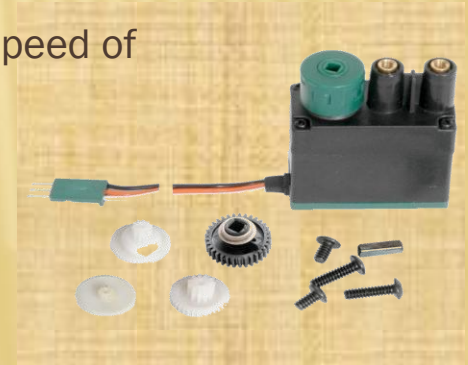
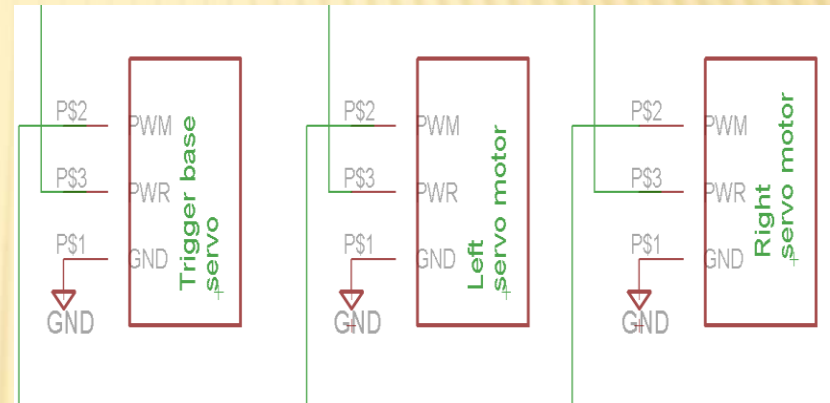
- Two Drive Motors

- Left/Right tread rotation controlled via PWM
    - MSP430 pins deliver PWM.
      - Pin 9 (P2.1) for left, pin 12 (P2.4) for right

- Pulses of 1ms (reverse) and 2ms (forward) correspond to max speed of 100rpm @ 7.5V

- One Turret Motor

- Range of rotation: 100 degrees.
    - MSP430 pin 10 (P2.2) for PWM signal.
    - No available timer in MSP, so a software timer is used.



# FIRING MECHANISM

- The firing mechanism consist of the solenoid which triggers the gun.It moves in the direction and fires with the help of solenoid.

- **Component:**

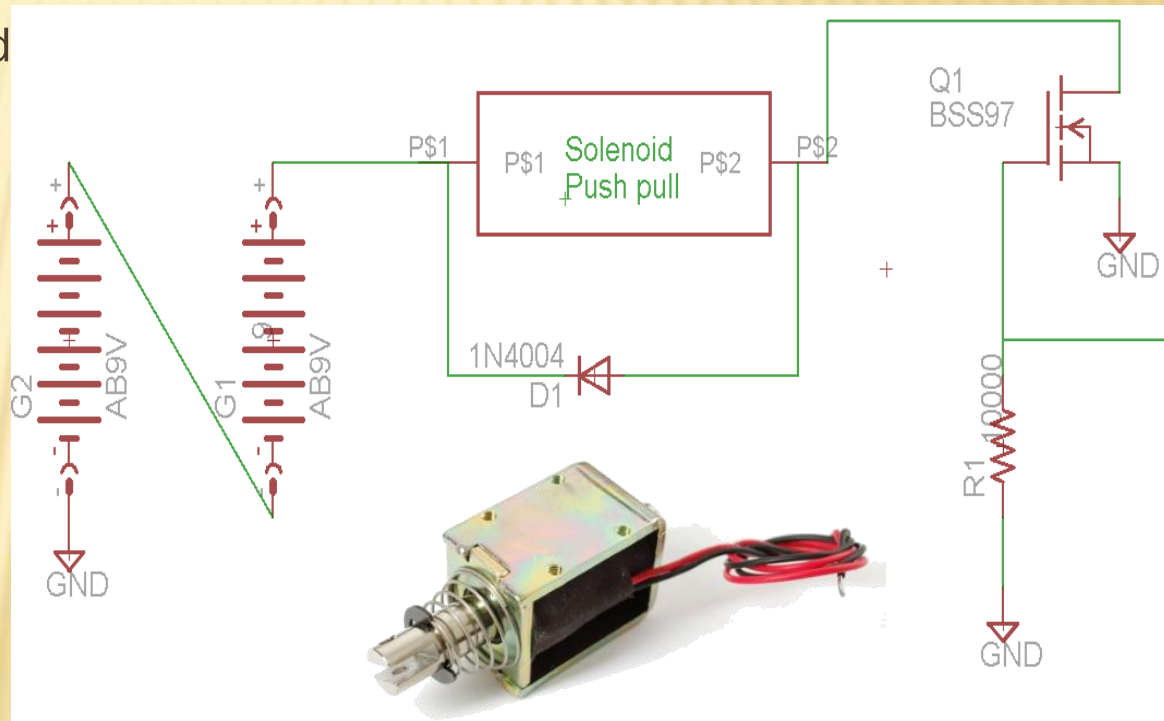
- Large Push-Pull Solenoid

- **Accompanied Circuit:**

- N channel MOSFET
  - 10K ohm resistor
  - Diode rectifier
  - 5V power source

- **Addressing from software:**

- High/low pin output





# SOFTWARE EXTRAS

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- ✘ Watchdog Timer to prevent runaway tanks.
- ✘ Low Power Mode 0 used whenever possible.
- ✘ Software Timer to make up for lack of available timers in MSP
- ✘ Added red LED to show “Armed” state.
  - + Can only fire when weapon is “Armed”
- ✘ Added green LED to show “TurretControl” state.
  - + Can only rotate turret when in “TurretControl” state.

**RESULTS**

**DEMO  
TIME!**

