Bi-wheel Robot Control

An application of PIC18F4431 MCU

MICROCONTROLLERS FOR MECHATRONICS

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Contents

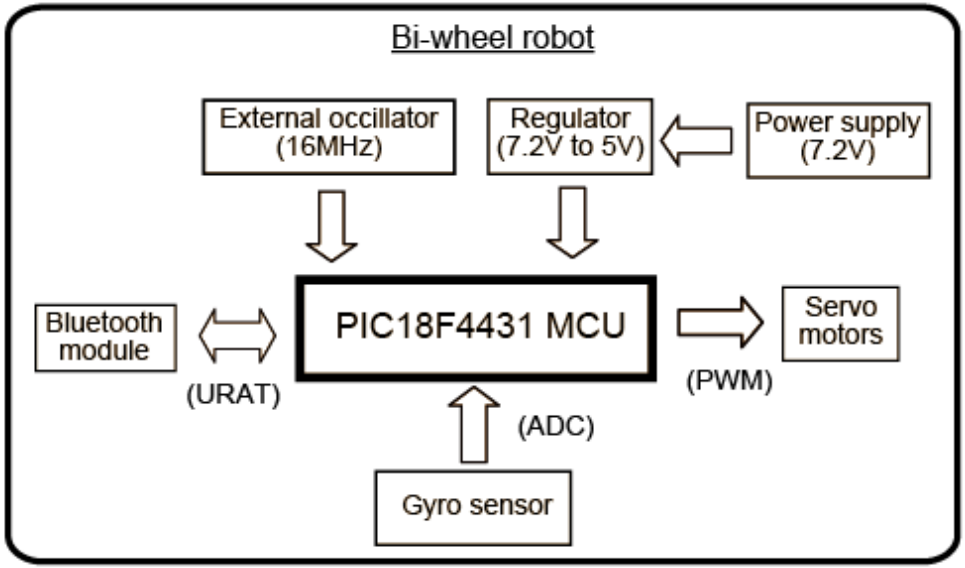
Introduction

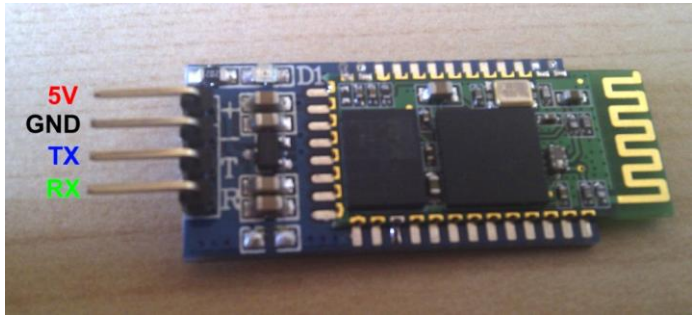
- Objective
  - Design an autonomous balancing and remote controllable bi-wheel robot (like a Segway).

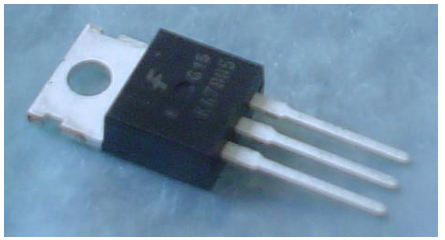
- PIC18 microcontroller and other devices.

The Bi-wheel Robot

- Hardware for the application







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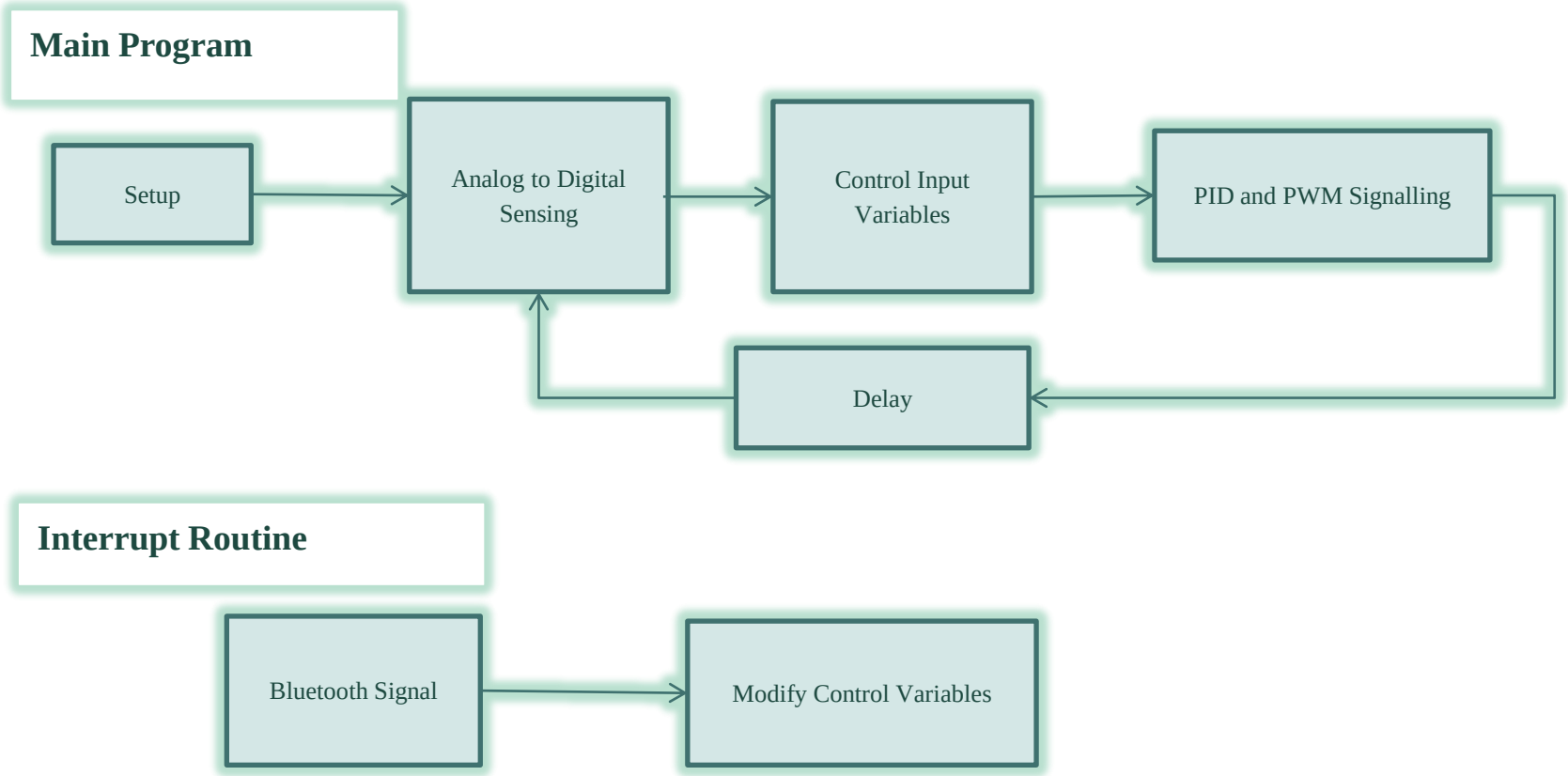
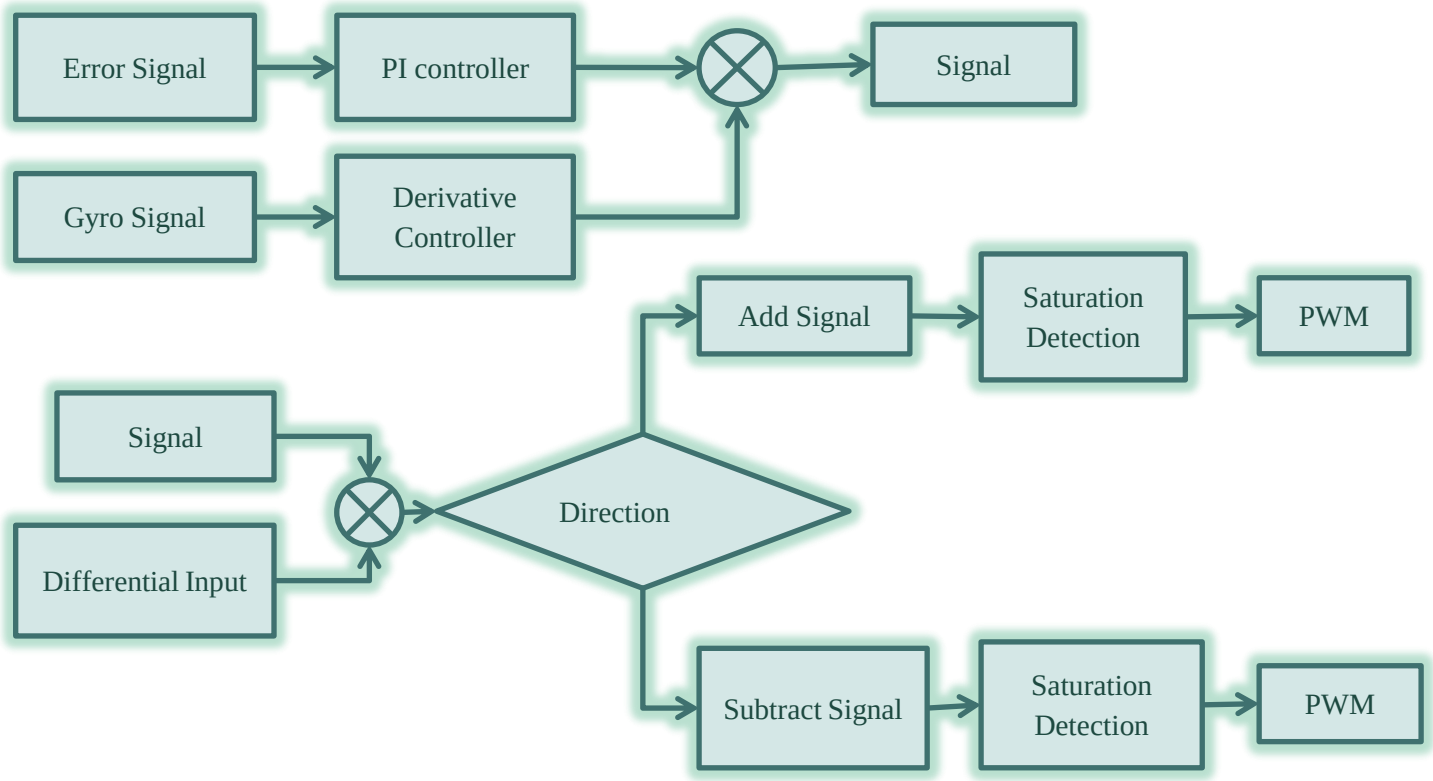
Control Algorithm Design

- Flowchart



Control Algorithm Design (cont.)

Control Signal Flow



Control Algorithm Design (cont.)

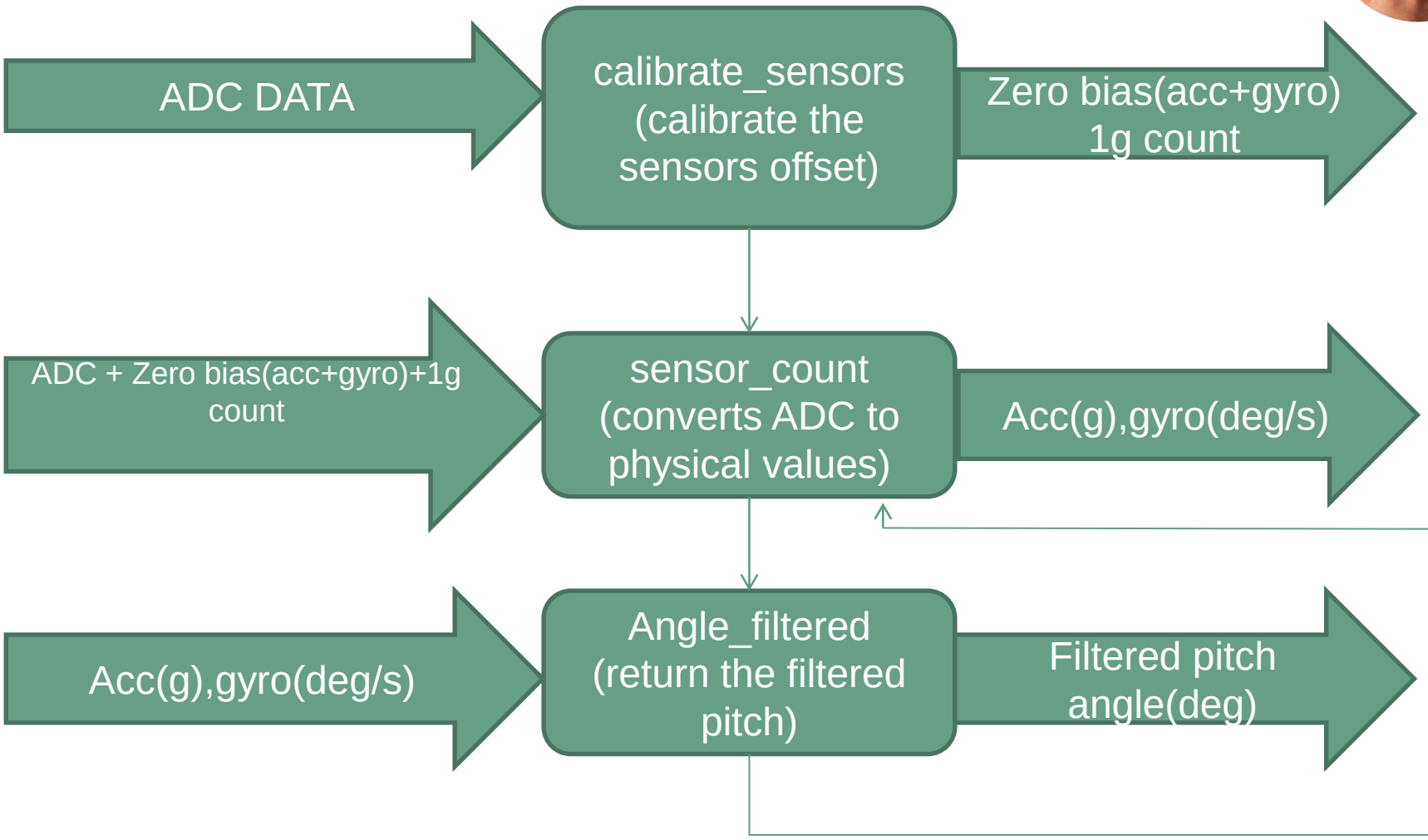
•IMU

- 3 axis accelerometer+ 2 axis gyro
- Accelerometer sensitivity :300mv/g 1.5V 0 g bias
- Gyro senitivity
- 9.1mv $\circ \frac{1}{s}$, 1.35V 0 bias

Control Algorithm Design (cont.)

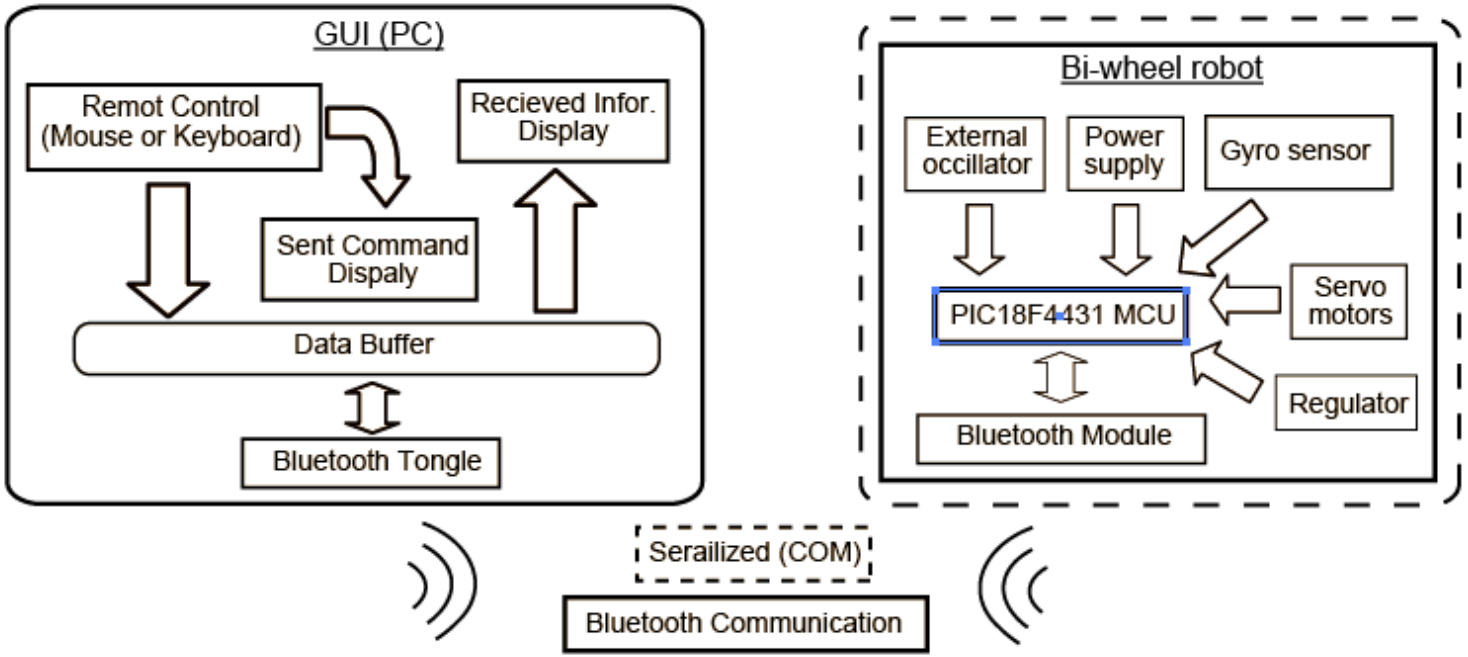
- Pic 18 ADC : 10 bits.
- Vref- =GND Vref+=3.3mv -> 3.222 mv/ count of resolution.
- Accelerometer 0 bias ~465 counts, 1g ~93 counts.
- Gyro 0 bias ~435 counts.
- Gyro data integration and gravity tilt are used in a complementary filter arrangement to approximate the tilt angle of the robot

Control Algorithm Design (cont.)



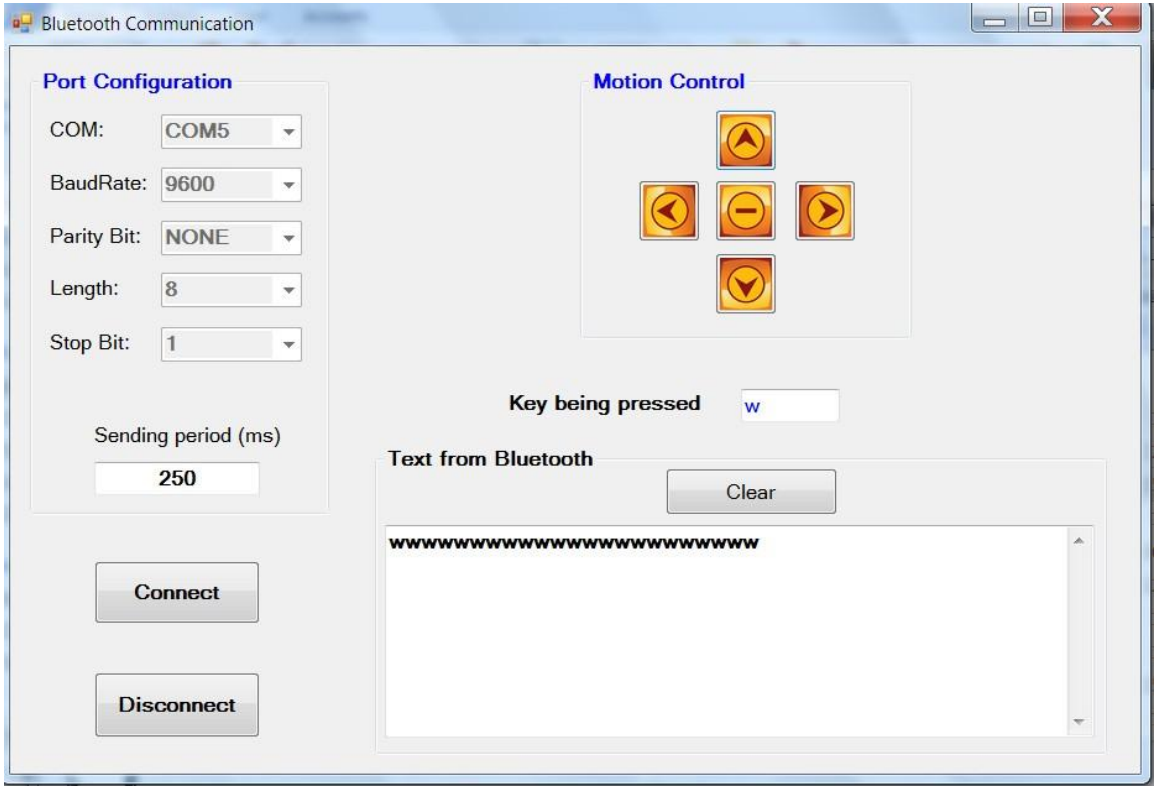
Control Algorithm Design (cont.)

- GUI and Bluetooth communication



Control Algorithm Design (cont.)

- GUI (PC)
  - A USB Bluetooth tangle
  - Add remote Bluetooth and paring



Control Algorithm Design (cont.)

- Bi-wheel robot
  - Connect RX pin of Bluetooth model to TX pin of the MUC (Pin 26), TX pin of Bluetooth module to RX pin of MCU (Pin 25);
  - Read control commands form Pin RX (*getsUSART()*), send to TX (*putsUSART()*)
  - Set high priority interrupt for command receiving event

Conclusion

- An application with PIC18 MCU, gyro sensor, servo motors, and Bluetooth module, by PI control.
- The bi-wheel robot is able to balance itself autonomously.
- Problems:
  - Hobby servo motor -- no speed control
  - 16K program memory for PIC18F4431-I/P

Future work

- Use DC motor instead.
  - Position control, velocity control, PWM
- An MCU with larger memory size.

(Demonstration)

Thank You !