Mechatronic Design

1. Software
   1. CPU
      1. CPU Architecture
         1. Von Neumann architecture
         2. Harvard architecture
   2. Microcontroller math and number manipulation
   3. Programming languages
   4. Embedded systems
   5. Microcontroller peripherals
2. Electronics
   1. Basic circuit analysis & passive components
   2. Semiconductors
      1. Diodes图片包含 文字, 白板

         描述已自动生成
      2. Transistor
         1. BJT
            1. BJT introduction图片包含 文字

               中度可信度描述已自动生成
            2. Darlington pair卡通人物

               描述已自动生成达林顿管放大倍数是两个三极管放大倍数的乘积，其一般作用是在高灵敏的放大电路中放大非常微小的信号，如大功率开关电路，常用于功率放大器和稳压电路中。
            3. The photo-transistor
         2. MOSFET卡通人物

            描述已自动生成
         3. Comparison between BJT & MOSFET
            1. Difference

BJT is controlled by current, while MOSFET is controlled by voltage.

When MOSFET is fully on, the conduction path behaves like a small value resistor rather than a fixed voltage drop.

* + - * 1. Application
  1. Operational Amplifier
     1. Comparators
  2. Real operational amplifiers & comparators
  3. Sensors
  4. Signal conditioning
  5. Digital inputs & outputs
     1. Representing logical gates
     2. Digital inputs
        1. Voltage requirements
        2. Current requirements
        3. Pull-ups & pull-downs

The state of the unused inputs should be determined, if left unconnected, they’re called floating inputs/引脚悬空. They can vary states randomly at very high frequency, which can induce extra power dissipation & substantial electrical noise.

* + - 1. Timing requirements
    1. Digital outputs
    2. Output meet input
  1. Digital outputs & power drivers
     1. Totem-pole outputs
     2. Open-collector/open-drain outputs

因为MOSFET的输入阻抗很大，电流相对较小，而BJT阻抗很小，电流很大，开集电极很容易导致电路烧坏，所以开集相对于开漏较少使用。

* + 1. Three-state outputs/output buffer
    2. Low side driver
    3. High side driver
    4. Half-bridges & full-bridges
  1. Digital logic & integrated circuits
     1. Basic combinatorial logic
        1. Truth table 真值表
     2. Combinatorial logic
     3. Sequential logic 时序逻辑
        1. Latch
           1. RS latch
           2. D-type latch
        2. JK flip-flop
        3. The counter
        4. The shift register
  2. ADC & DAC
  3. Voltage regulators, power supplies & Batteries

1. Actuators
   1. Permanent Magnet Brushed DC Motor Characteristics
      1. Electrical model图片包含 文字, 地图

         描述已自动生成
      2. Characteristic constants for permanent
   2. Permanent Magnet Brushed DC Motor Application
      1. Inductive kickback/spiking 电感反冲
      2. Bidirectional control of motors using H-bridge circuits
      3. Speed control with PWM (Pulse Width Modulation)

Voltage & current ripple will occur if a long period is chosen, which is much longer than the mechanical constant of the system.

* 1. Solenoids
  2. Brushless DC Motors
  3. Stepper Motors
     1. Function: used for positioning with limited demands for fast response & extreme accuracy.
  4. Other actuator technologies
     1. Pneumatic & hydraulic systems
     2. RC servos
     3. Piezo actuators
  5. Basic Closed-Loop Control
     1. PID control
     2. Tuning

1. Mechatronic Projects & Systems Engineering