

INTRO

- Goal
 - Know where to look for the information you need for your own microcontroller projects
 - Be able to figure out how most embedded systems work
 - Understand how everything pass the OBC works and be able to service/modify it

Terminology

- Embedded system
- Microcontroller (uC)
- CPU
- AVR
- Arduino
- Package (IC)
- Motor driver
- Motor controller
- PWM
- “Serial port”

THE “WHAT”

PC

- CPU – GHz
- RAM – GB
- HDD – TB
- IO – USB, Firewire, RS232...
- Cost – \$1k+
- Power – 100W+

uC

- CPU – MHz
- RAM – kB
- FLASH – kB
- IO – pins, pins, and pins
- Cost - \$1-10
- Power - mW

PC

- Code in X86
- Compile **on** X86
- Compile **for** X86
- Run in X86 (.exe)

uC

- Code in PC
- *Cross-compile* **on** X86
- *Cross-compile* **for** AVR
- *Download image* to AVR
- Run in AVR (.hex)

THE “HOW”

- Setup
- AVR
 - GPIO (output)
 - PWM
 - ADC
 - GPIO (input)
 - Interrupt
 - USART
- Application

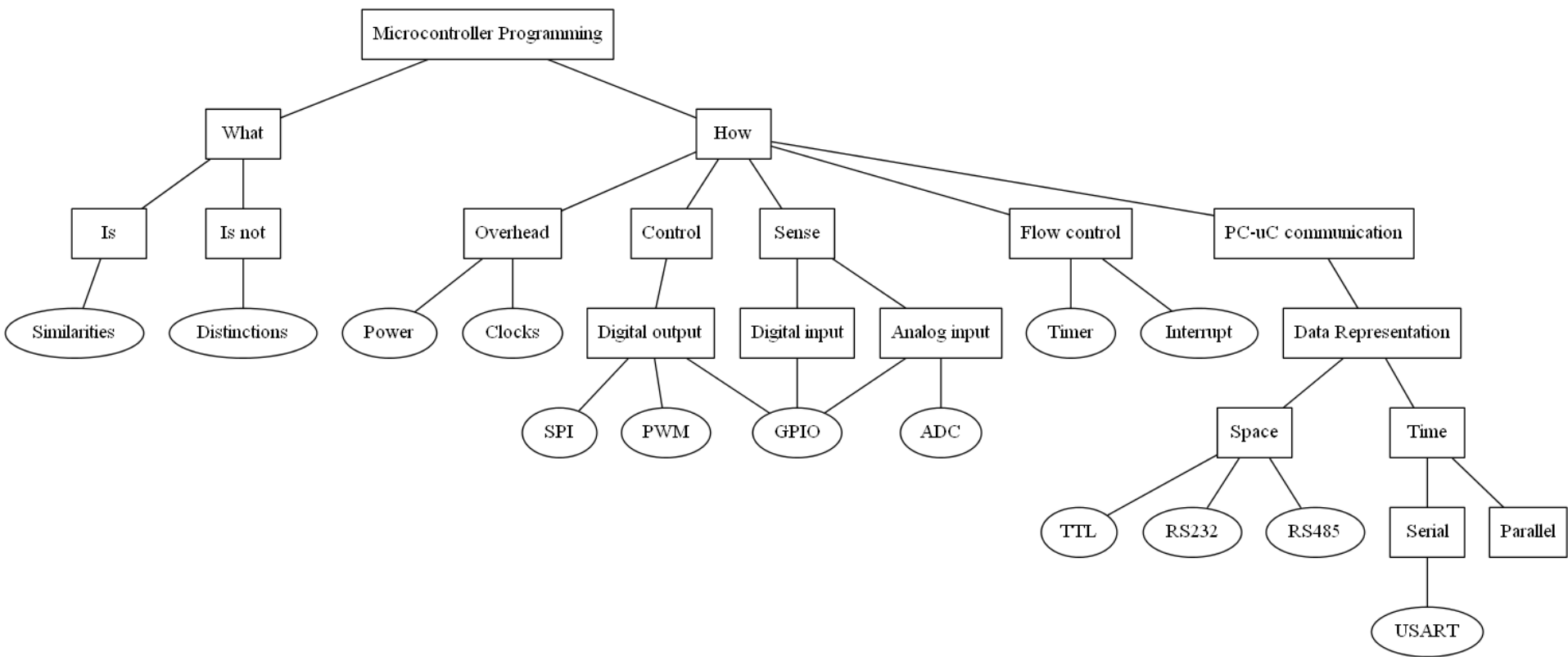
- IDE calls the tool chain in sequence:
 - **Preprocessor**
 - Source files -> source files
 - **Compiler**
 - Source files -> object files
 - **Linker**
 - Object files -> binary image
 - **Flash loader**
 - Image download

- Sensing
 - Distance (ultrasonic, SHARP IR)
 - Acceleration & angular velocity (accelerometer, gyro)
 - Magnetic field, temperature, humidity, pressure...
- Control
 - PID
 - DC motor, servo, stepper...
- Character LCD, dot-matrix LED...

CASE STUDIES

- Rover volt/temp monitor
- Rover pan-tilt controller
- Rover drive motor controller
- Rover arm controllers

SUMMARY

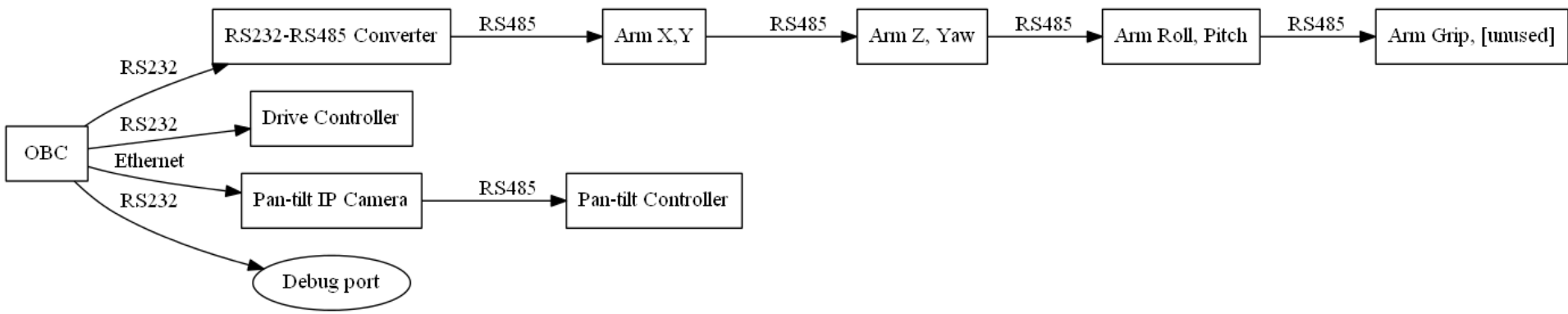


Limitations

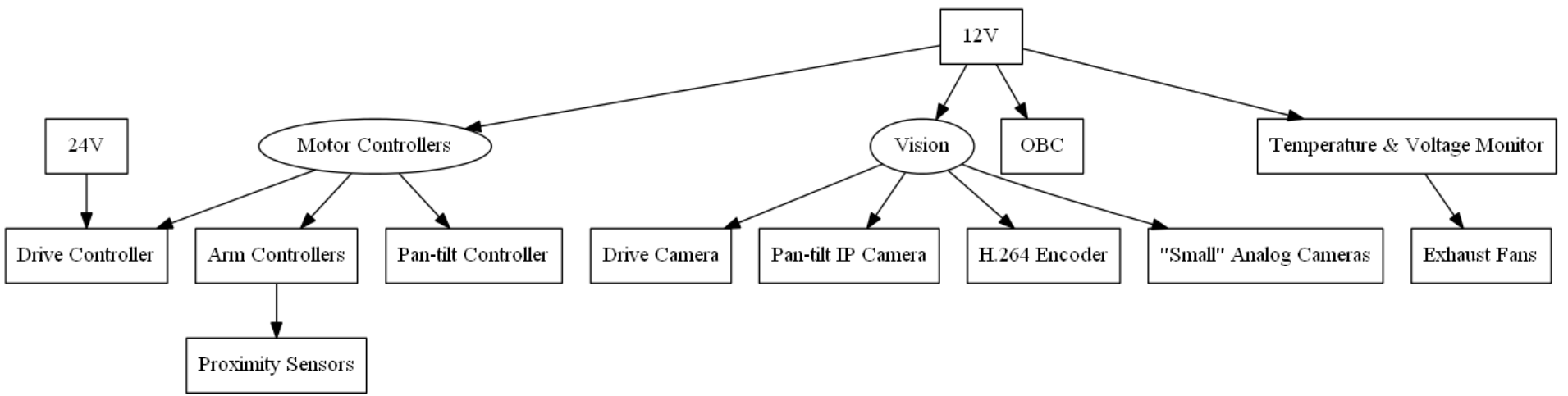
- Did not cover
 - Timing, clocking
 - C libraries
 - I2C, SPI
 - uC operating system
 - Watchdog
 - Boot flash
 - Too many other topics
- *Arduino Wire/Processing*

I am working on...

- Or hope to be working on
 - Accelerometer (ADXL345)
 - Gyro (ITG3200)
 - Bluetooth and XBee
 - Ragel
 - Graphviz
 - Processing (the language)



Control signal between OBC and Motor Controllers



2011 Rover 12V Distribution by Physical Wiring

“One of the goals of education is to make people aware of how little they know.”

- AVR library
 - <http://www.nongnu.org/avr-libc/user-manual/modules.html>
- Graphviz
 - <http://www.graphviz.org/Gallery.php>
- Processing (the language)
 - <http://processing.org/learning/topics/>

- Code examples

- <https://sites.google.com/site/stanleylio/home/yurtuc>