Lecture 11

Team Learning
Embedded Computing and Making

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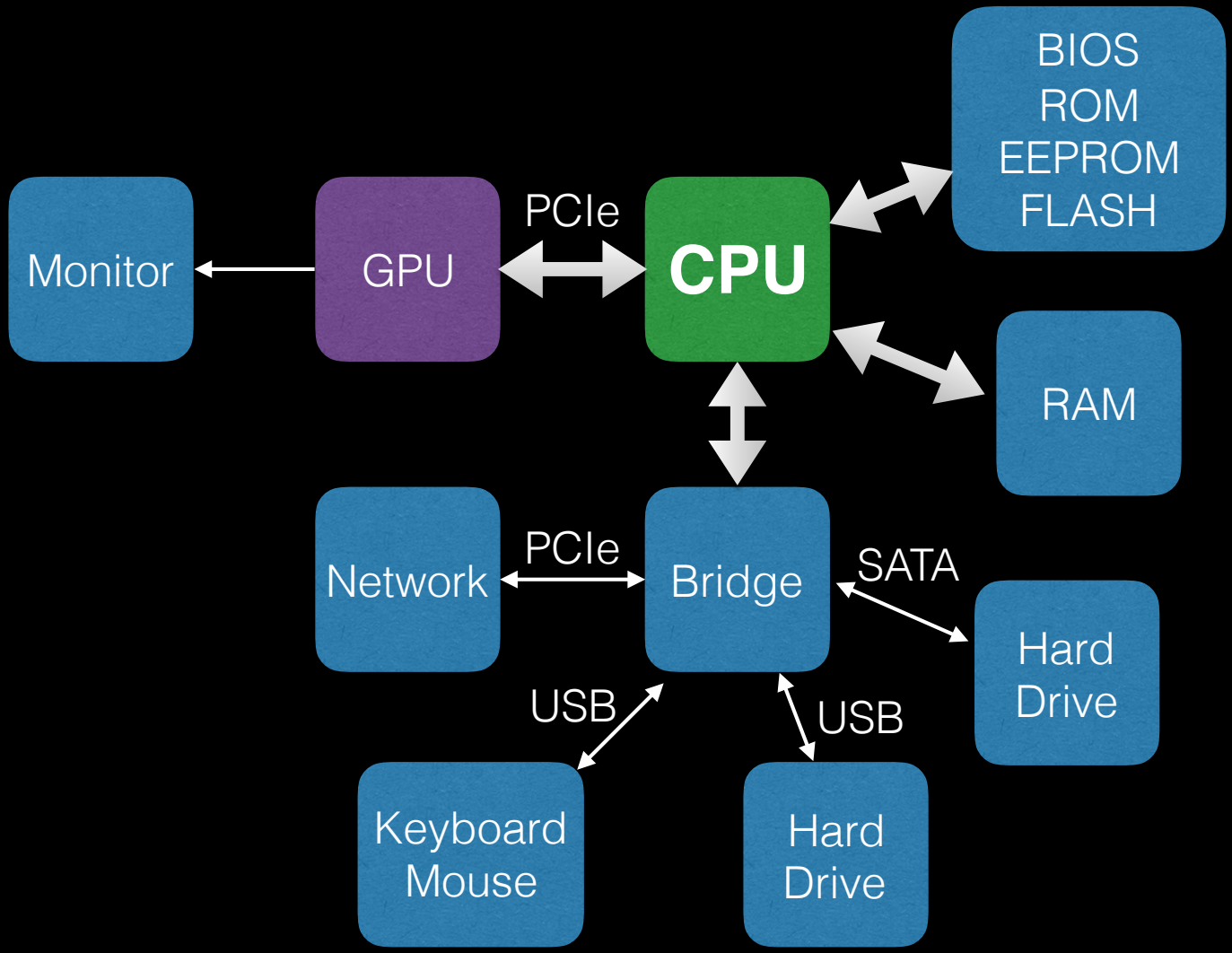
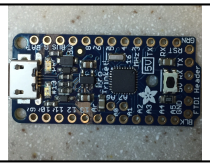
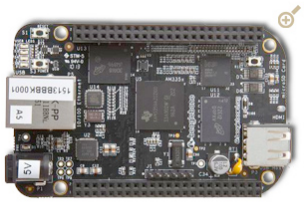
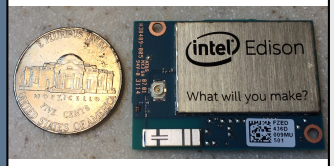
Inside a Computer



Making

- Computer controlled Mills and Lathes
- 3D Printers
  - http://www.thingiverse.com/
  - http://3dprint.nih.gov/
- Embedded processors
  - sensors
  - motors
  - displays

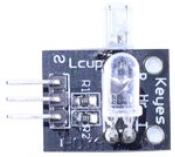
Embedded Computers

		OS	Speed	I/O	Cost
Arduino		None	8/16 Mhz	14-54 digital, 6-14 PWM, 6-16 analog + Shields !	$6-65
Trinket Pro		None	16 Mhz	18 digital, 2 analog, 6 PWM, 1 SPI	$9
BeagleBone Black		Linux + Ard I/O	1 Ghz	HDMI, Ethernet, 2 USB, 65 digital, 8 PWM, 4 timers, 7 analog, 4 serial, 2 I2C, 2 SPI	$45
Raspberry Pi2/3/0		Linux	900 Mhz quad	4 USB, HDMI, Vid, Audio, Ethernet, SD, Camera, GPIO, I2C, SPI	$35
Intel Edison		Linux	Dual Core 500Mhz	WiFi, Bluetooth 4, I2C, SPI,14 digital, 4 PWM	$40

Arduino


LEGEND
GND
POWER
CONTROL
PHYSICAL PIN
PORT PIN
ATMEGA328 PIN FUNC
DIGITAL PIN
ANALOG-RELATED PIN
PWM PIN
SERIAL PIN
ARDUINO PIN
Source Total 150mA
Source Total 150mA
General Information
Pay Attention
No Really PAY ATTENTION
LED
THE UNOFFICIAL ARDUINO UNO PINOUT DIAGRAM
GND
VIN
2.1 m
7-12v depending on current drawn
POWER BARREL JACK
USB JACK
Absolute max per pin 40mA reccomended 20mA
Absolute max 200mA for entire package
Reserved
R3 Only
IOREF
RESET
3V3
5V
GND
GND
Vin
ATMEGA328
ICSP
RESET
SCK
MISO
5V
MOSI
GND
SCL
SDA
AREF
R3 Only
Sink Total 100mA
Sink Total 100mA
Sink Total 100mA
Connected to the ATMega and used for USB program and communicating with it
www.pighixxx.com
29 JAN 2013

Sensors


Finger-Pulse sensor Module

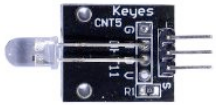

Hall sensor Module


Microphone sensor Module

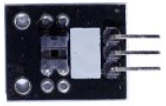

Obstacle avoidance sensor Module


Passive Buzzer Module


Flame sensor Module


Colorful Auto-flash Module


infrared-transmit Module


Light break sensor Module


Magnetic spring Module


Digital-Temperature sensor Module


High-sensitive voice sensor Module

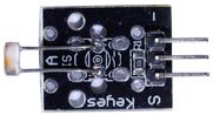
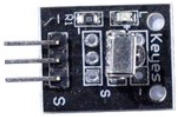


Photo resistor sensor Module


Metal touch sensor Module


hydrargyrum-switch sensor Module


Infrared-receive sensor Module

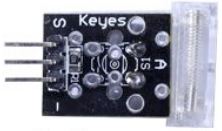

RGB LED Module


Push button Module


humiture sensor Module


Laser-transmit Module


two-color commoncathode LED Module


Knock sensor module


Tracking sensor Module


tilt-switch Module


Shock-switch sensor Module


Rotate-encode Module

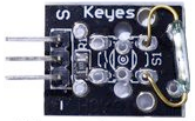

Relay Module

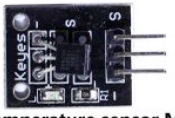

Joystick PS2 Module


common-cathode RED&GREEN LED Module


Linear-Hall Sensor Module


Active buzzer Module


Magnet-ring sensor Module


18b20 temperature sensor Module


RGB LED Module


Analog-temperature sensor Module


Magic-ring Module

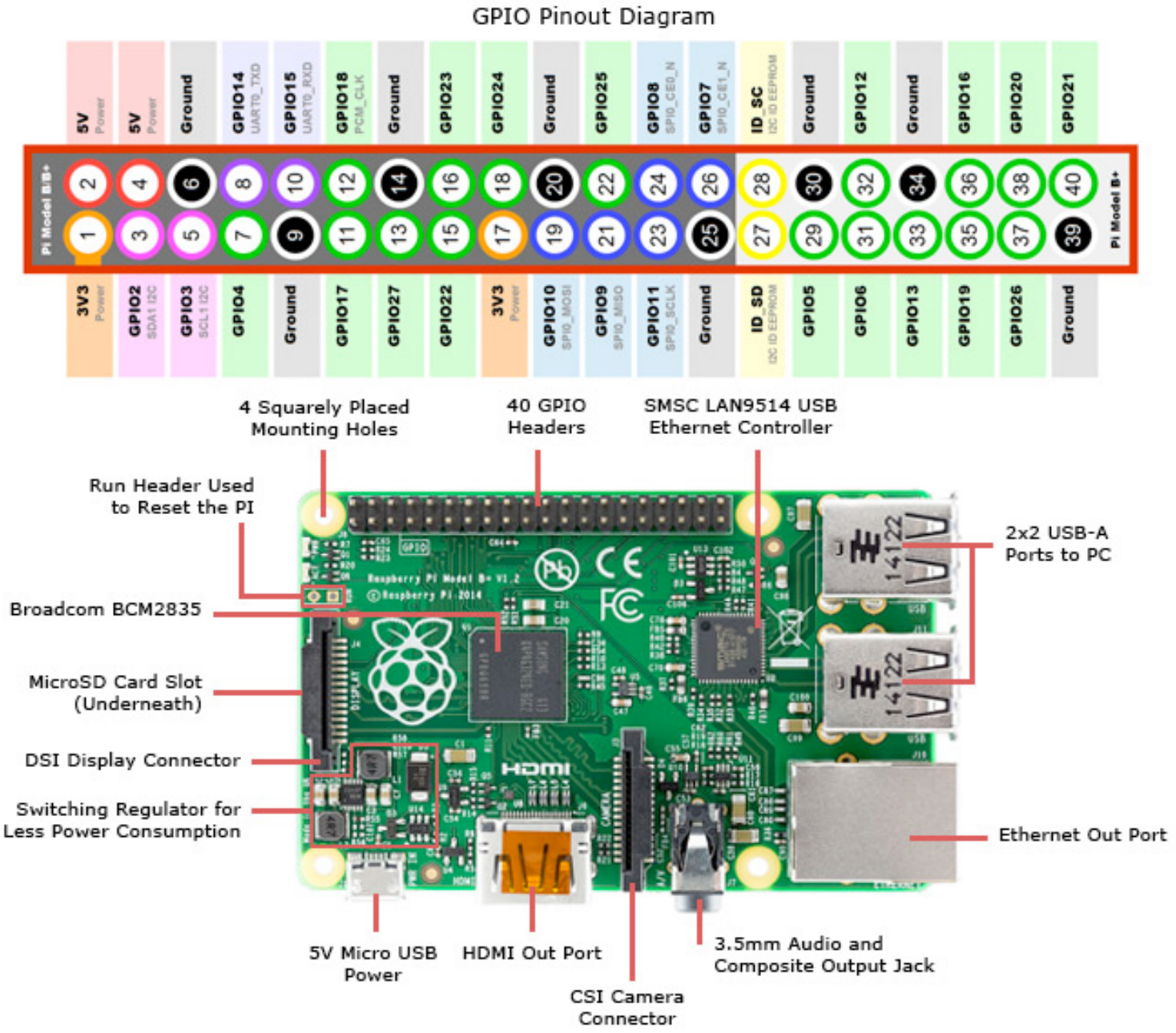
Motors

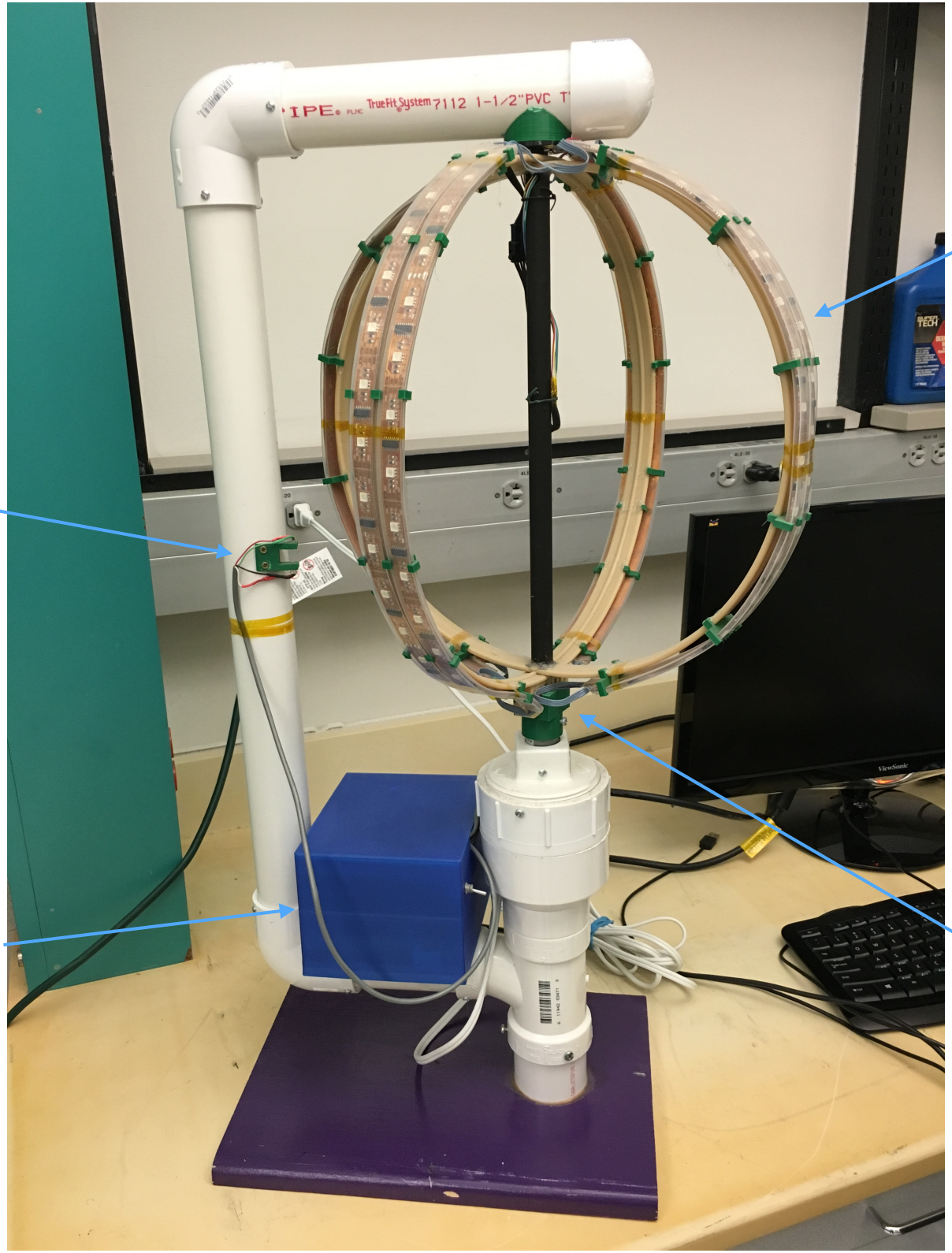
DC/AC Motor	Speed Control	Constant Voltage with Duty Cycle	1 PWM & Power Amp
Gearbox Motor	Speed Control	Same, but slower	1 PWM & Power Amp
Continuous Servo	Digital Speed Control	PWM Controls Speed	1PWM
Standard Servo	Control Angle	PWM Controls Angle	1PWM
Stepper	Digital Positioning	Stepping Sequence	Unipolar: 4 digital + Amp

Raspberry PI2

- The Raspberry Pi is a series of credit card–sized single-board computers developed in England, United Kingdom by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools and developing countries → $35
- A 900MHz quad-core ARM Cortex-A7 CPU (~0.35 GFlops) Linux PC
- 1GB RAM
- 4 USB ports, HDMI, Ethernet
- 40 GPIO pins
- Camera interface (CSI)
- Display interface (DSI)
- Micro SD card slot
- VideoCore IV 3D graphics core

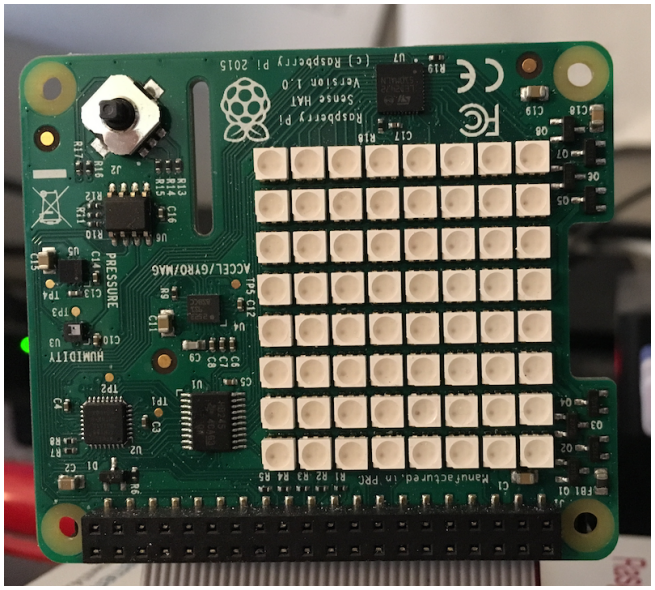
Raspberry PI2




LED
Strip
Optical
Sensor
Raspberry
Pi and Motor
Controller
Motor

3 Choices

- NeoPixel Strip with 8 RGB Pixels (x10)
  - 8 Pixel strip, full RGB
  - easiest
- SenseHat (x4)
  - 8x8 RGB display
  - mini-joystick
  - 6 Environmental Sensors



- Camera Module (x1)
  - Good quality still/video camera

CLASS PROJECTS

- Must do something useful in some specific context
- Not be trivial
- If you have past programming experience I will expect more

- **Please follow these instructions exactly:**
- Your class project MUST be submitted by **11:59 PM on Sat, Feb 24**. No revisions will be accepted after this time. You can use Sunday to prepare your oral presentation
- Your submission should consist of:
- one or more .py files (should have sufficient comments to figure out how they work)
- any necessary additional files to demonstrate that the program works
- A 1-2 page PDF file with a brief description of your program, what inputs the program takes, what outputs the program produces, and what it is supposed to do.
- The final item in the PDF should be a command-line to use in running the program, and any necessary instructions to demonstrate that it works.
- Combine all files into a .zip file named: Familyname_Givenname_project_2018.zip
- Email sludtke@bcm.edu with the subject "Class project submission", and attach the .zip file. If the file is too large for email, feel free to transfer it via Box, DropBox, etc.