Embedded Software

CmpE244

Sept. 29 (Wed) 4:10-8:00pm.

Zoom Link To Be used for the Entire Semester

Harry Li, Office: Eng. Building Rm 269A

E-mail: hua.li@sjsu.edu.

Text messages (650)430-6116.

Grading Policy:

1° Projects & Assignment 30%

2 mandatory Projects, 10%×2 = 20%

1 Semester-Long Project 10%

2° Midterm: 30%

3° Final: 40%

Organization of the Course

1. CPU Architecture, memory map. Special Purpose Registers for the init & config of Peripheral Controller. Firmware Development. (~3 weeks)

2. Kernel (O.S) Source Distribution IDE (Integrated Development Environment), To be able to optimize Kernel image, to be able to modify existing Device Drivers. to write your own Device Driver. (~3 weeks)

3. Integration & Development of O.S. Kernel + Device Driver + Sensors/Actuators

Stepper Motor Drive
Sensors LSM303
P.I.D controller.
Fourier Transform.
Web Server (GUI)
OpenCV, OpenGL

Introduction

1. Development Setup

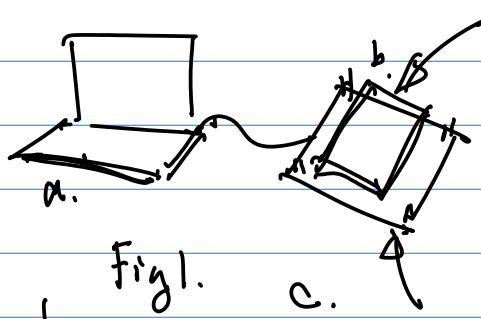


Fig 1.

c. Wire Wrapping Board

a. Host PC/Laptop, Linux Ubuntu 18.04

(Virtual Box Installed, then install Linux on top of it.

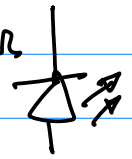
b. Target platform (To Be determined)

c. Wire Wrapping Board

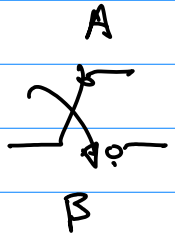
① ~$3\frac{1}{2}$" x 4" physical Dimension Through Holes with metal coating.

(2) 4 mounting Holes @ the corners. 4 stand-offs (Legs)

(3) LED Red/Green Current $\leq 10mA$
Resistors $V_{LED} \cong 1.8 VDC$
200 ~ 500Ω



(4) Toggle switch



3. Selection & Evaluation of A Target platform

Linux O.S. Support

ARM (RISC — Reduced Instruction Set Computer)

- Most Efficient Computation Density Per Unit Power
- Reduced Instruction Set (Smaller collection of machine code instructions → Better Optimization of compiler)
- Forward Looking — Longer Life Cycle

2. OS. Architecture

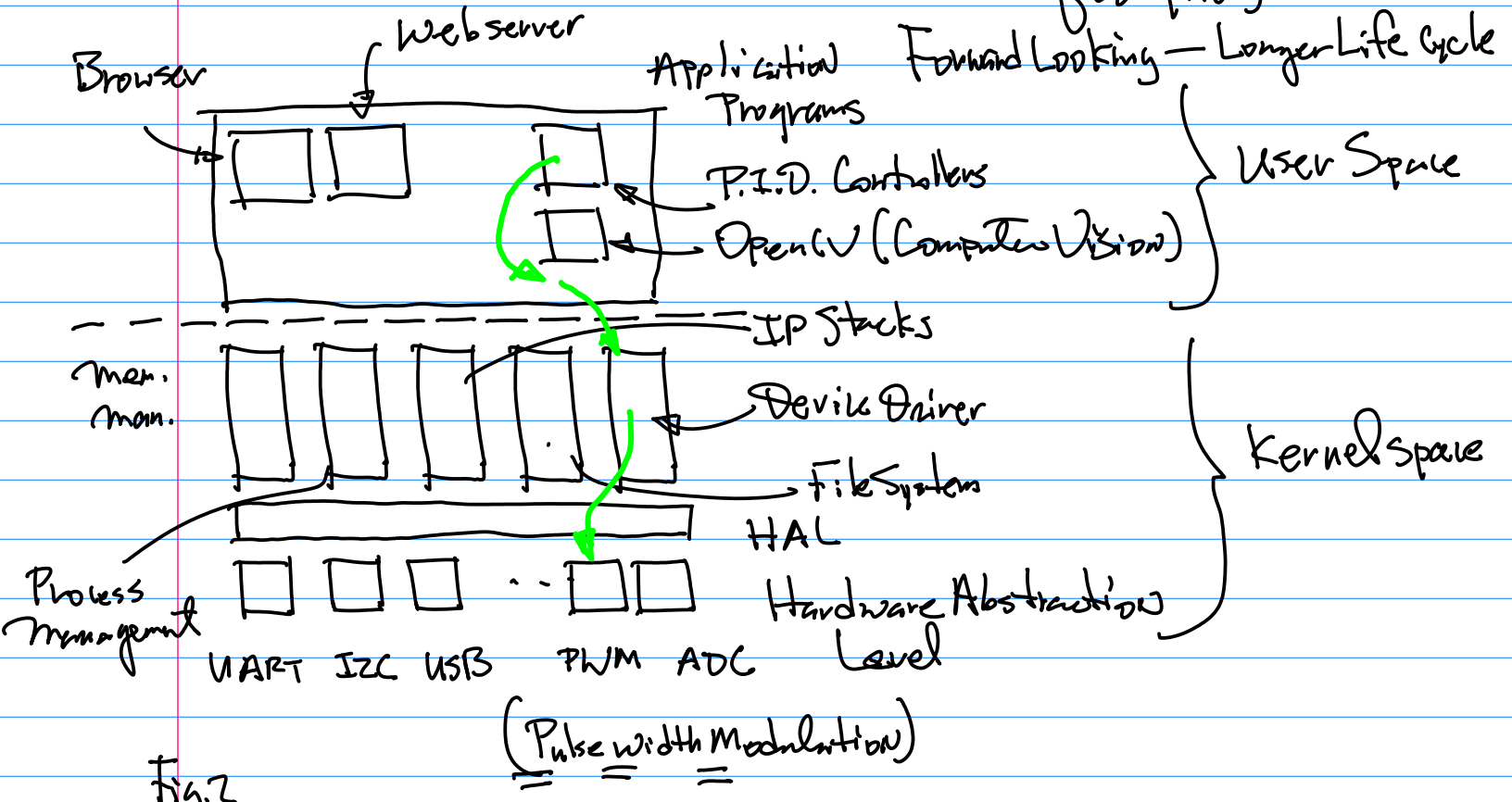


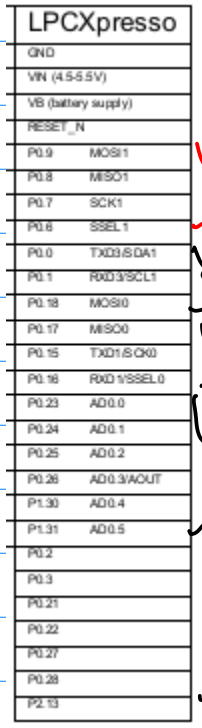
Fig. 2

Target Platforms To consider

1. NXP LPC17xx, 1769
   Clock Rate: ~~72~~ 100MHz – 400MHz
   RTOS But Not Unix OS.
   No Linux
   Rich I/O Interface
   Ref: git~2021F-107b- . .

CPU Datasheet —— CPU Architecture well Documented
Memory map well Documented

Example: Sch of LPC1769.



"3+1" pin: SPI1 (Serial Peripheral Interface)

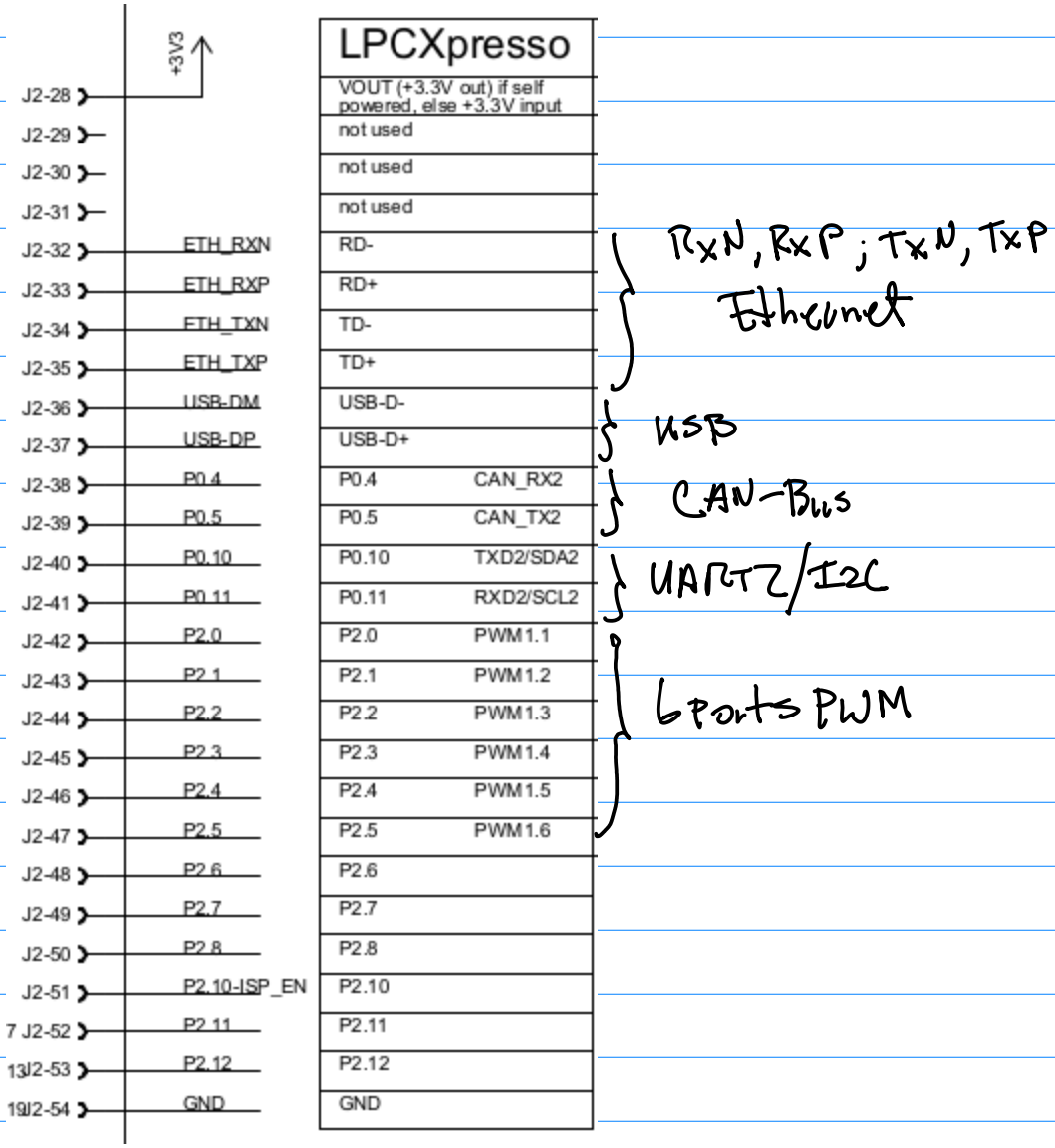
UART3{ Tx Transmission / Rx Receiving } multiplexed

SPI0/UART1

SDA: Serial Data
SCL: Serial CLK
I2C

6 ADC (AD — Analog to Digital Conversion)

GPP (GPIO: General Purpose Port I/O)



Option Target platform: FPGA. Futus Electronics.

FPGA Igloo2: RISC-V.

Superset of ARM Architecture

IP Core: Open Source. Supports RTOS

Limitations: No Unix/Linux O.S.

Smaller Gate Counts. → Less

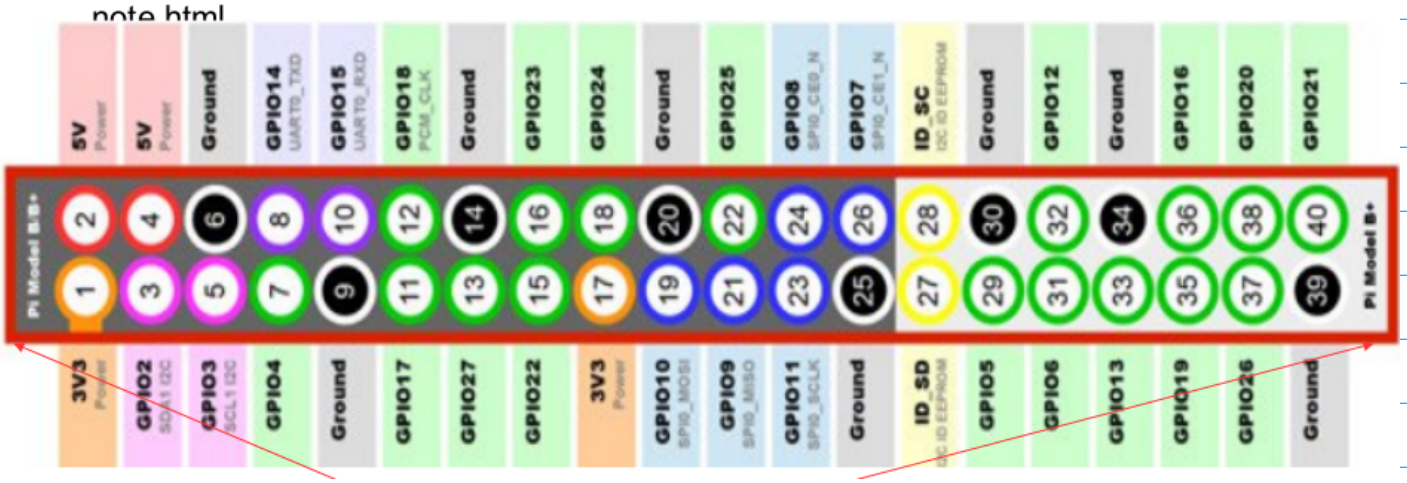
Computational Capability.

Pie. Broadcom BCM

Features: Support Linux/Ubuntu.
Provides machine/Computer Vision Capability; OpenCV.
YoLo (You only Look Once) — Deep Learning, NO ADC

Pie-3 Version B GPIO Pins

https://www.jameco.com/Jameco/workshop/circuitnotes/raspberry-pi-circuit-note.html



Pins: CPU Datasheet → Device Driver Development.
CPU Architecture (memory map, Peripheral Controllers, G.E. (Graphics Engine))

Option: ARM-11 Samsung. CPU: S3C6410x
CPU Datasheet: Architecture Block Diagram — well Document
600~800MHz memory map, well Designed, documented
Support Linux, well Document/Sample code for Driver Development.

State-of-the-Art Feature: Graphics Processing Engine — GPU
LPC17xx, NO; FPGA RISC-V, NO; BCM-Pie G.E. yes
ARM-11. Video Codec, Marginal

Option: NVDA — Jetson TX2 6 CPUs + 256 GPU in a Single Package

Supports Linux/Ubuntu, I/O Interface is limited ; (LPC17xx has the Best I/O I/F Support) ; ~$70 Dev. Kit. Well Documented Datasheet.

Sign up as a developer at nxp website

www.nxp.com

MCU Xpresso

Option: NVDA Jetson NANO. Ubuntu Linux Support.

- Multiple Cpus + 128 GPU
- I/O (Limited)
- Datasheet — Not As Detailed as other platform)

Developer forum is very Active and it gives a good references.

Homework: 1° Form 2-4 person team By Next week ;

2° Choose Target Platform

3° Bring WireWrapping Board/ Prototype Board to the Class for show & Tell ;

4° Sign up @ Nvidia website as a developer → Kernel (Ubuntu)

- Source Distribution
- Jetpack