Mobile Robots (EECN30169/535307)

Lec 2:Embedded Computing Platform

Kai-Tai Song
Institute of Electrical And Control Engineering
National Ying Ming Chiao Tung University
EXT: 31865, Email: ktsong@nycu.edu.tw
URL: http://isci.cn.nctu.edu.tw

2022/9/23

Outline:

- On-board Computing Platform
- ROS Programming Environment
- Check Point 1

PC-Based Systems

Arm

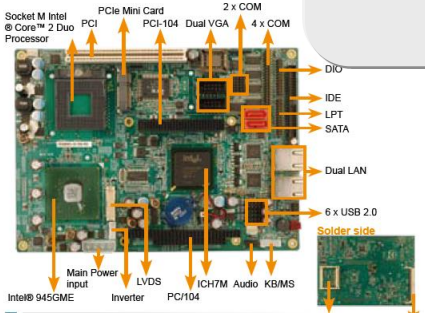
Shoulder servo driver and motor

Elbow servo driver and motor

Gripper servo driver and motor

Robot Arm DSP Motion Control Card

Industrial PC



Head

Pan servo driver and its motor

Tilt servo driver and its motor

Robot Head DSP Motion Control Card

Robot - Foot DSP Motion Control Card

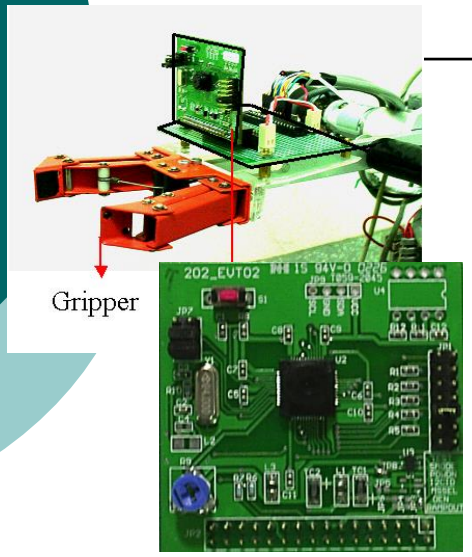
Left Servo driver and its motor

Right Servo driver and its motor

Foot

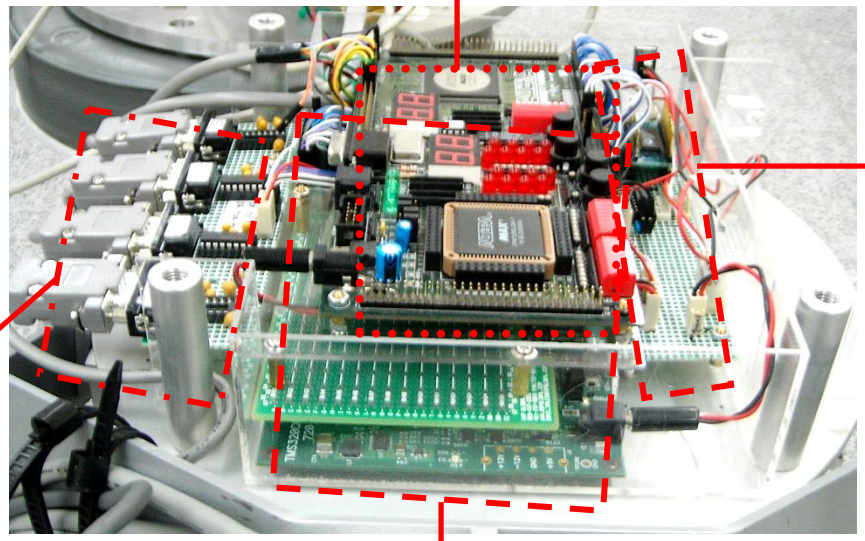
The motion control of the robot is implemented using a DSP chip , thus the PC can reserve more resources for other advanced functions.

DSP-Based Vision System



CMOS sensor board EVT202

Using an FPGA to generate control signals for the DSP board

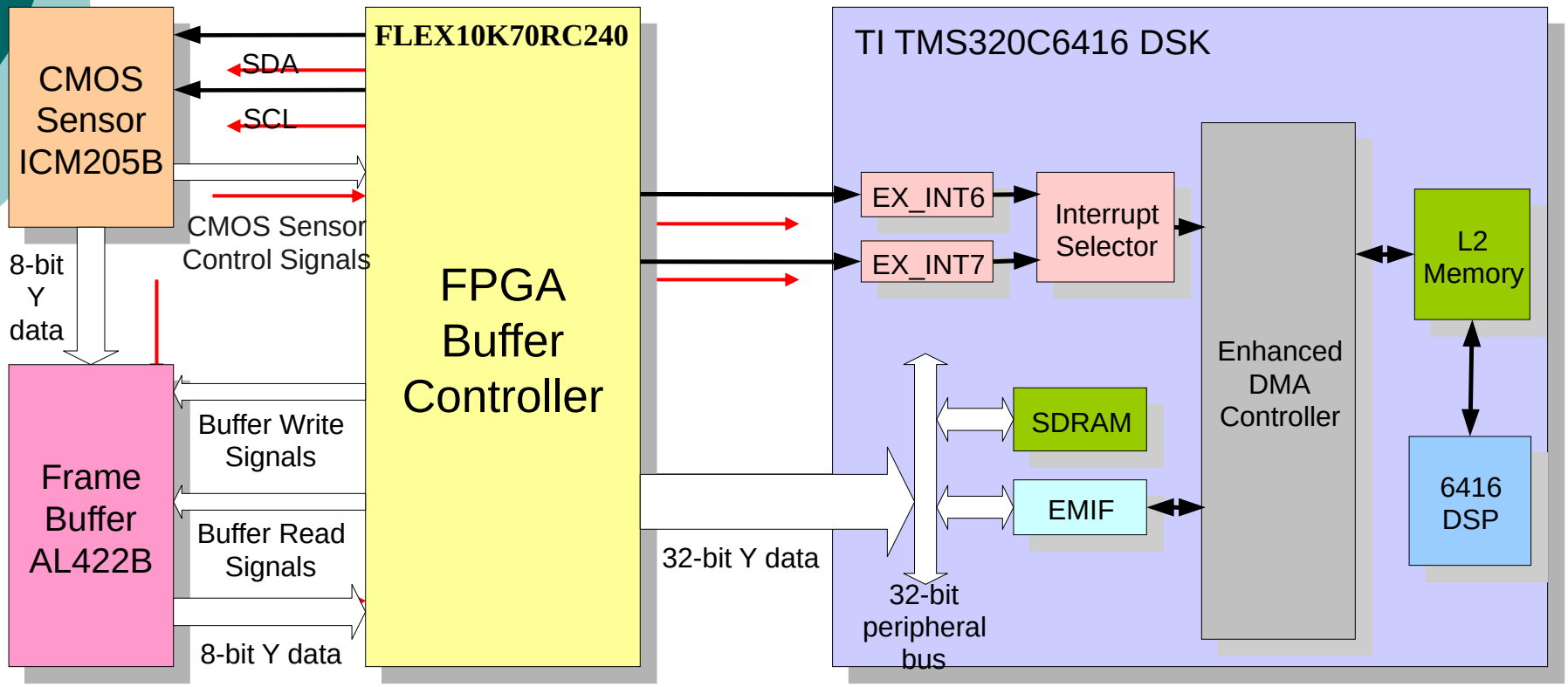


A frame buffer is used to store image data

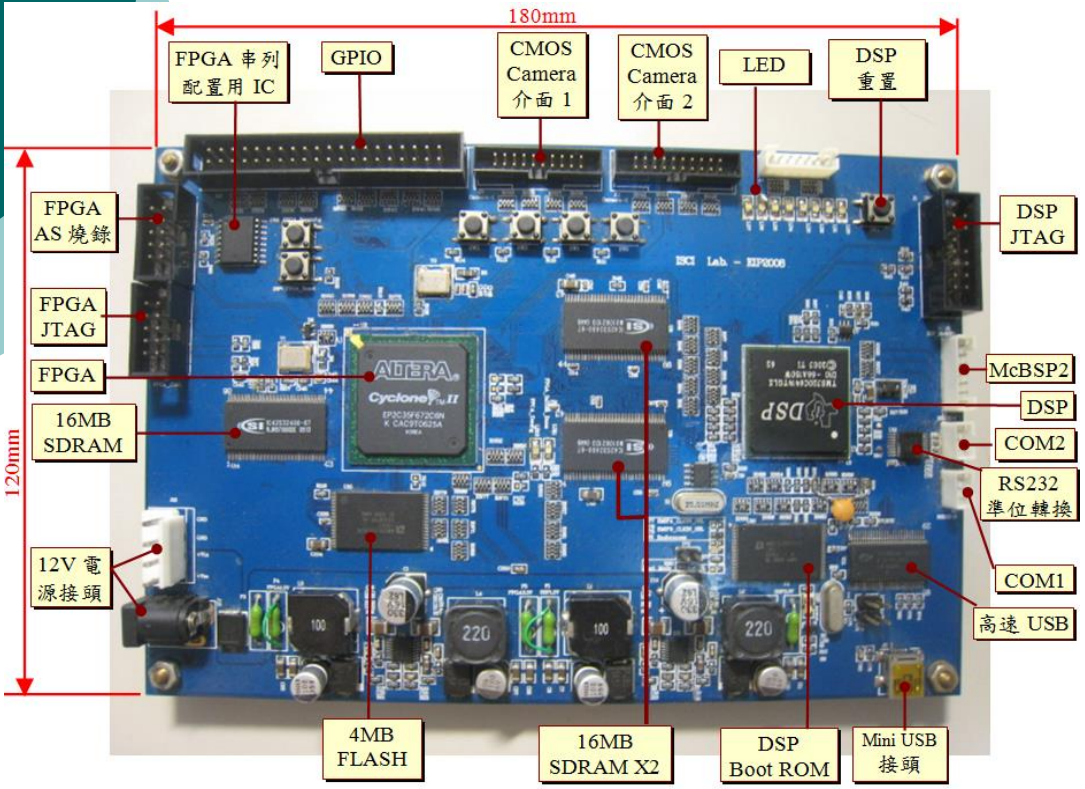
Four COM ports for DSP board to communicate motors and other devices.

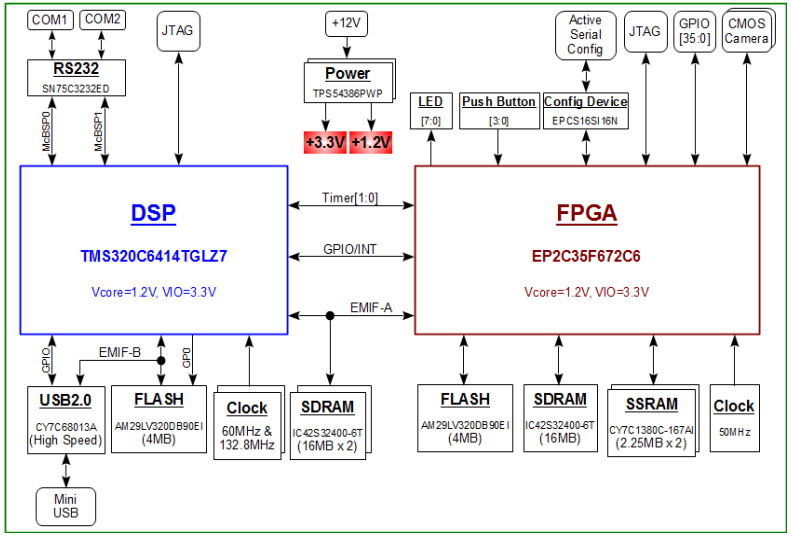
TI TMS320C6416 DSP board

Embedded Imaging System



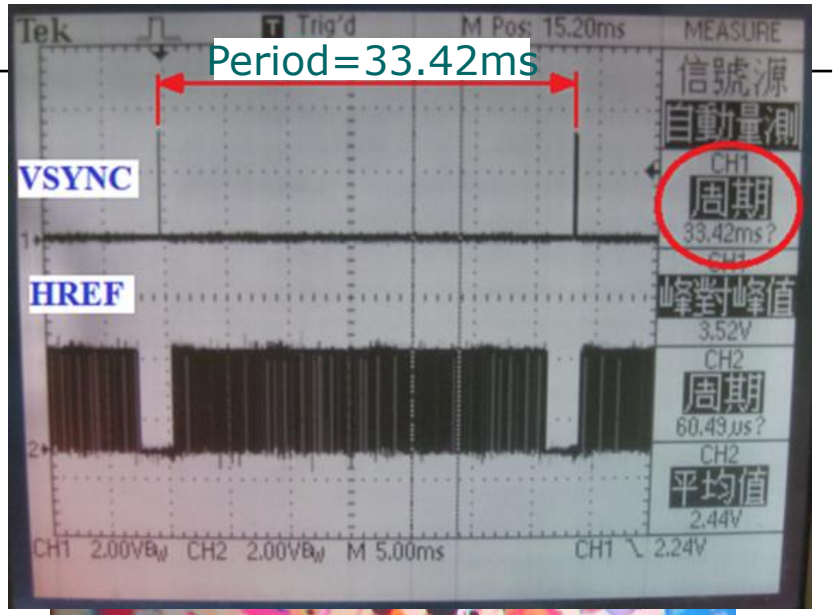
Embedded Imaging Board





Experimental Results

- Average Refresh Time:33.5ms



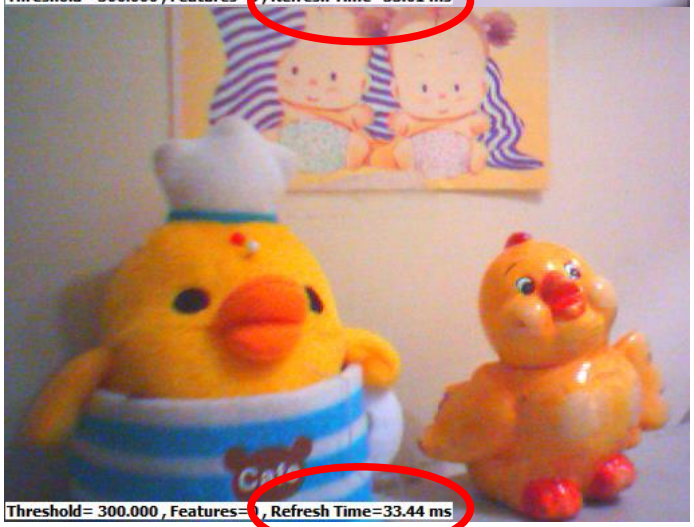
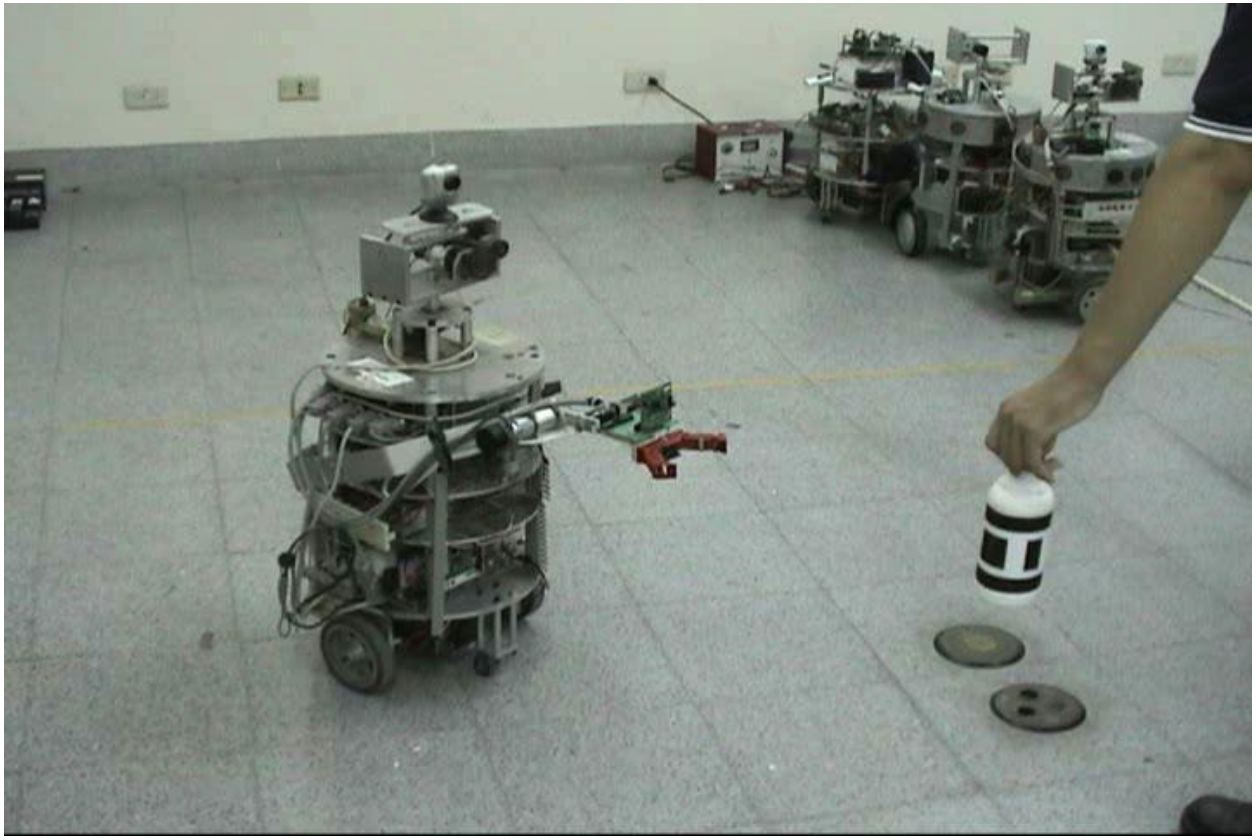


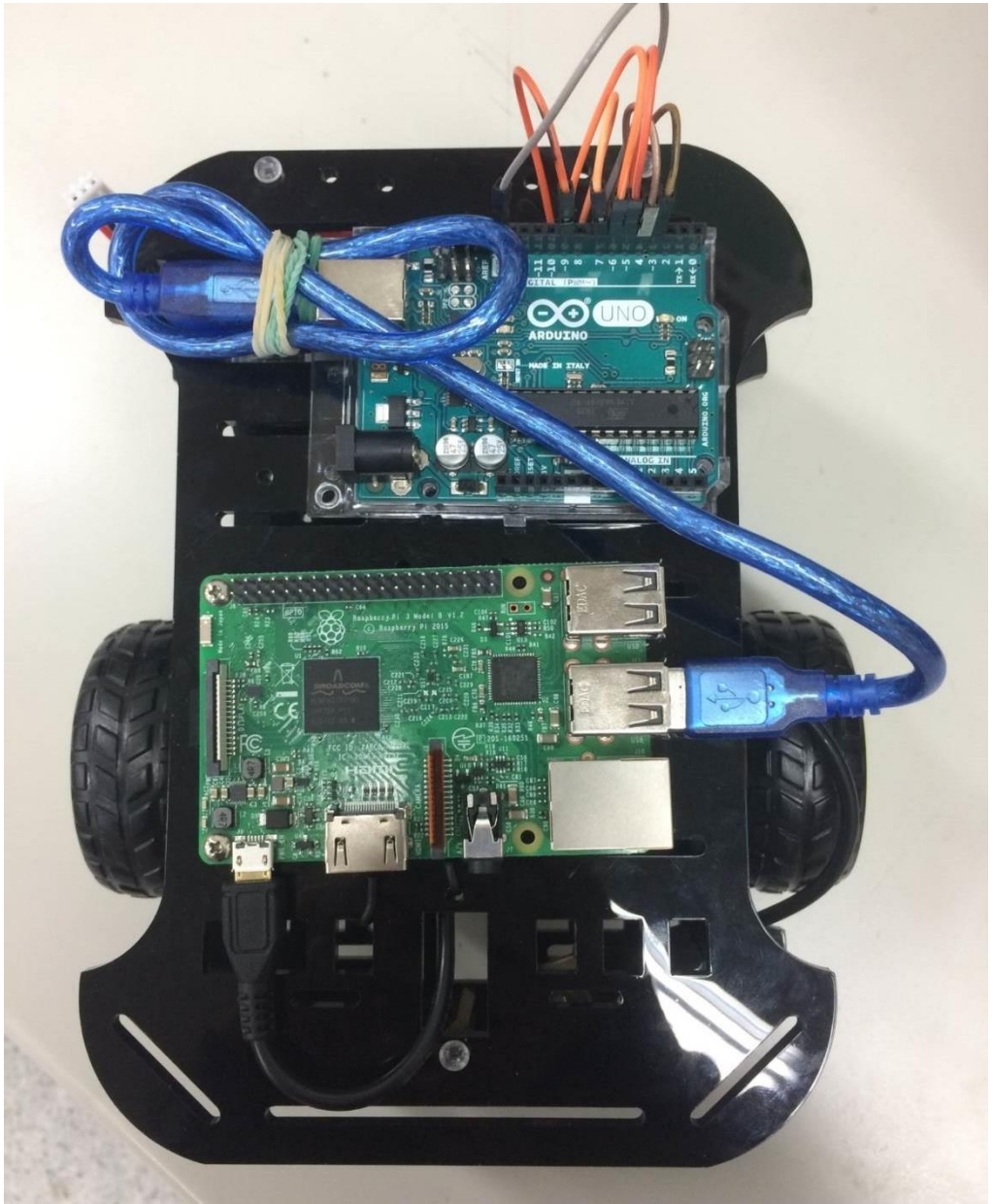
Image-Guided Grasping



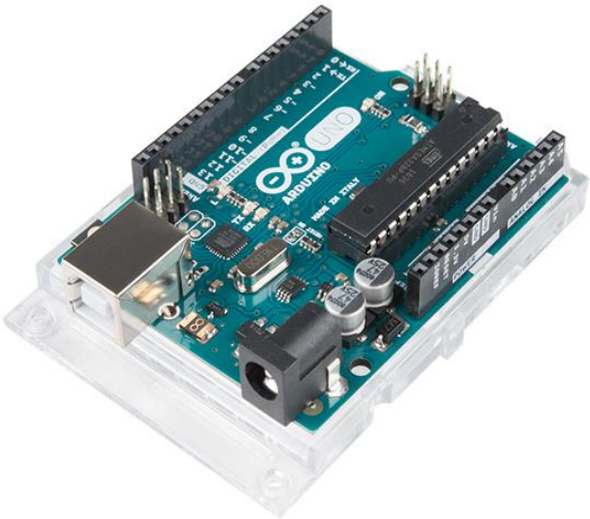
EECN30169 on-board computers

Arduino UNO

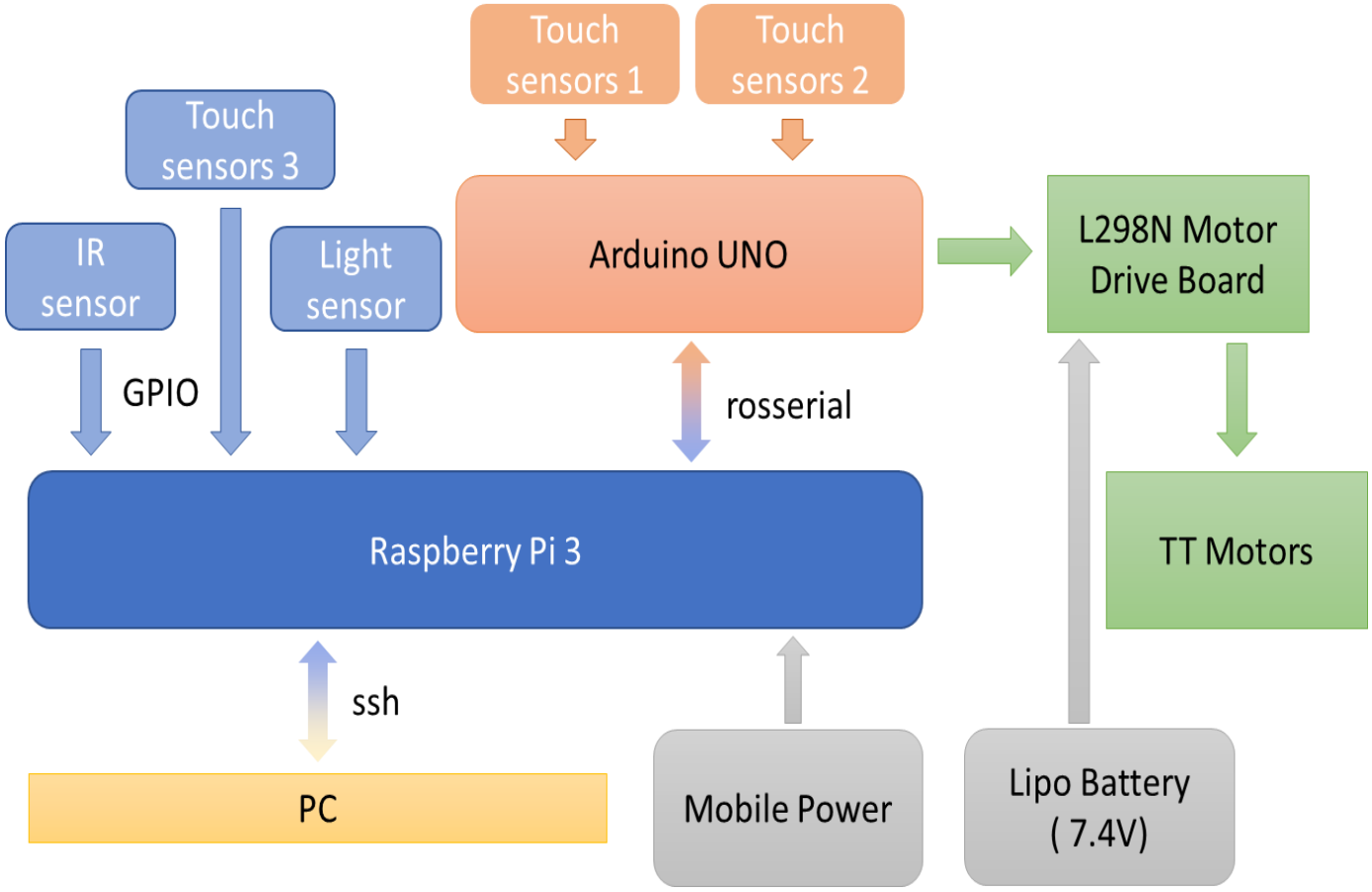
Raspberry Pi3



On-board Computing Platform



Mobile Robot Control System



Raspberry Pi 3 Model B

SoC：Broadcom BCM2387 chipset
CPU：4-Core ARM Cortex-A53、1.2GHz
Display：Dual Core VideoCore IV
Memory：LPDDR2、1GB
Connectivity：10/100Ethernet、IEEE802.11 b/g/n
WiFi、Bluetooth 4.1（
Video output：HDMI（rev 1.3、1.4）、Composite（NTSC、PAL）、3.5mm sound connector
USB：4 USB 2.0
GPIO：40-pin 2.54 mm ，27 GPIO and +3.3 V、+5 V、GND utility connectors。
Camera connector：15-pin MIPI（CSI-2）
Display Serial Interface（DSI）


RAM 1GB LPDDR2
BROADCOM BCM2837
1.2GHz QUAD CORE
USB 2.0
USB 2.0
10/100
ETHERNET
GPIO CONNECTOR
CHIP ANTENNA
85mm
56mm
RCA
VIDEO/
AUDIO
JACK
DSI DISPLAY
CONNECTOR
HDMI
CSI CAMERA
CONNECTOR
MICRO SD CARD
SLOT (underside)
STATUS LED

Checkpoint #1 Raspberry Pi and ROS

The purpose of checkpoint 1 is to make sure you have an embedded computing system for the robot. It consists of the hardware and the development environment for programming your robot.

A. Use *ssh* command to remote connect to Raspberry Pi from your PC, and use *rosversion* command to show that you already install ROS Kinetic on Raspberry Pi. (30%)

B. Use command and library from rosserial package to create a program which contains publishers and subscribers. It means that your Raspberry Pi should send and receive messages to and from Arduino. In this program, Arduino should receive a number from Raspberry Pi, multiply it by 2, and then send it back to Raspberry Pi. Show the result on Terminal. (70%)