Smart Software Project

Lecture: Week 1

Course Overview

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Today

- What is this course all about?
  - Description
  - Course structure
  - Course requirements: lab, exam, term project
  - Assessment/Grade
- What is Smart Software?
- Real-World Examples
- Class Schedule
- Class Ethics
- Announcement

Smart Software Project (37269-01, English-taught Lecture)

- Instructor: Prof. HyungJune Lee
- Teaching Assistant: Dahee Jeong
- Classes
  - Time and Location
    - Mon 2:00pm – 3:15pm (Lecture), Asan 125-2
    - Mon 3:30pm – 6:15pm (Lab), Asan 122

Instructor: Prof. HyungJune Lee

- Contact information
  - Office: Asan Eng. Bldg. 321-1
  - Tel #: 02) 3277-6644
  - Email: hyungjune.lee@ewha.ac.kr
  - Homepage: http://home.ewha.ac.kr/hyungjunelee
  - Office hour:
    - Thu 3:30pm – 5:00pm

Teaching Assistant: Dahee Jeong

- Contact information
  - Office: Asan Eng. Bldg. 329
  - Tel #: 02) 3277-3505
  - Email: ssp.ewha@gmail.com
  - Office hour
    - TBD

English-taught Lecture

- You have a higher chance of getting A or B grade
- English-taught classes would eventually help you to grow as global engineers
  - Most of recent hot technology information accessible in English!
- Note that this is NOT an English language class
  - Homework score will not be judged by English ability

Course Objective

- Hands-on embedded system programming and project course based on Arduino hardware and software
  - Open-source electronics prototyping platform
  - Simple and cost effective development environment (starting from $30)
  - Over 300,000 commercial products as of mid-2011

- Students will learn
  - Real-world embedded system programming
    - Design of hardware & software system
    - Interface
    - Configuration
  - Applying computer architecture to embedded programming
  - Implementing smart robot software as a term project

Textbook and References

- Textbook
  - There is no textbook required for this course
- Lecture note will be uploaded in Ewha Cyber Campus before each class
  - http://cyber.ewha.ac.kr
- References
  - Official Arduino website
    - http://www.arduino.cc
  - Arduino Mega 2560 board website
    - http://arduino.cc/en/Main/arduinoBoardMega2560
  - Any Arduino-related programming book
    - Programming Arduino Getting Started with Sketches (번역본 "스케치로 시작하는 아두이노 프로그래밍")

Course Structure

- Lecture class + lab session
  - Lecture class
    - Fundamental concepts of embedded system – hardware & software, MCU, communication
    - Interconnecting other embedded devices
    - Robot control: line tracing, ultrasonic sensing
  - Lab session
    - Practice in-lab embedded programming exercises based on the lecture materials
    - Term project

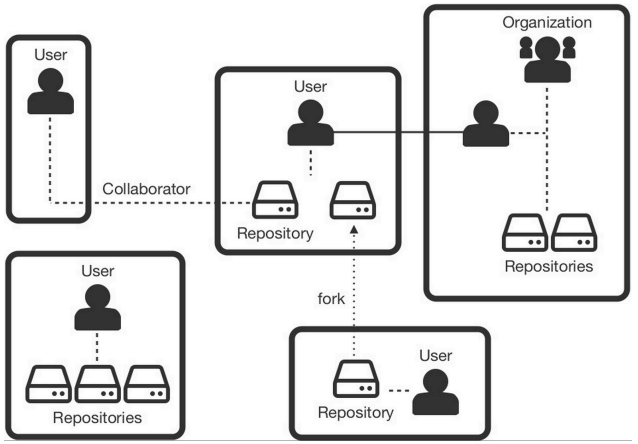
Programming Environments

- Arduino IDE
  - Windows
  - Mac OS X
  - Linux

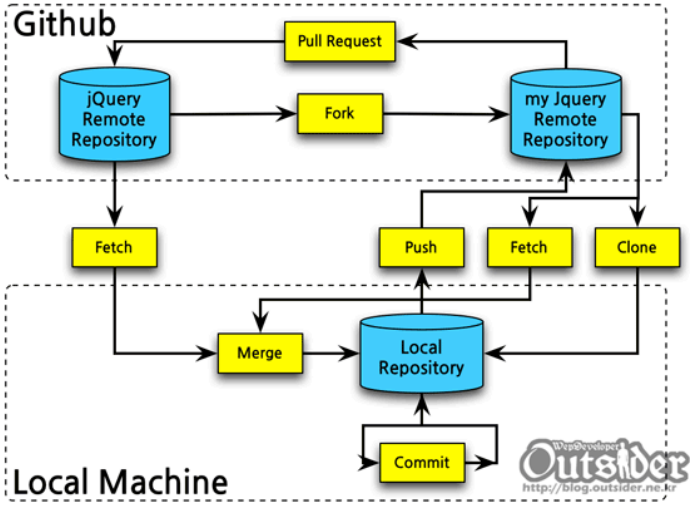
- Embedded programming
  - Arduino Mega 2560-based SmartCAR Robot platform
  - Nexus 7 Android tablet

Project Code Repository

- Need a version control system
  - Files: main.c, wifi.c, bt.c,..
  - Manage the version history of each file
  - Also, manage a set of working files
  - With multiple collaborators
  - Each revision is associated with (timestamp, person) making the change
  - Ex) Git, CVS, SVN, …
- + web-based hosting service
  - Ex) GitHub



["Git & GitHub & kintone" at Slideshare]



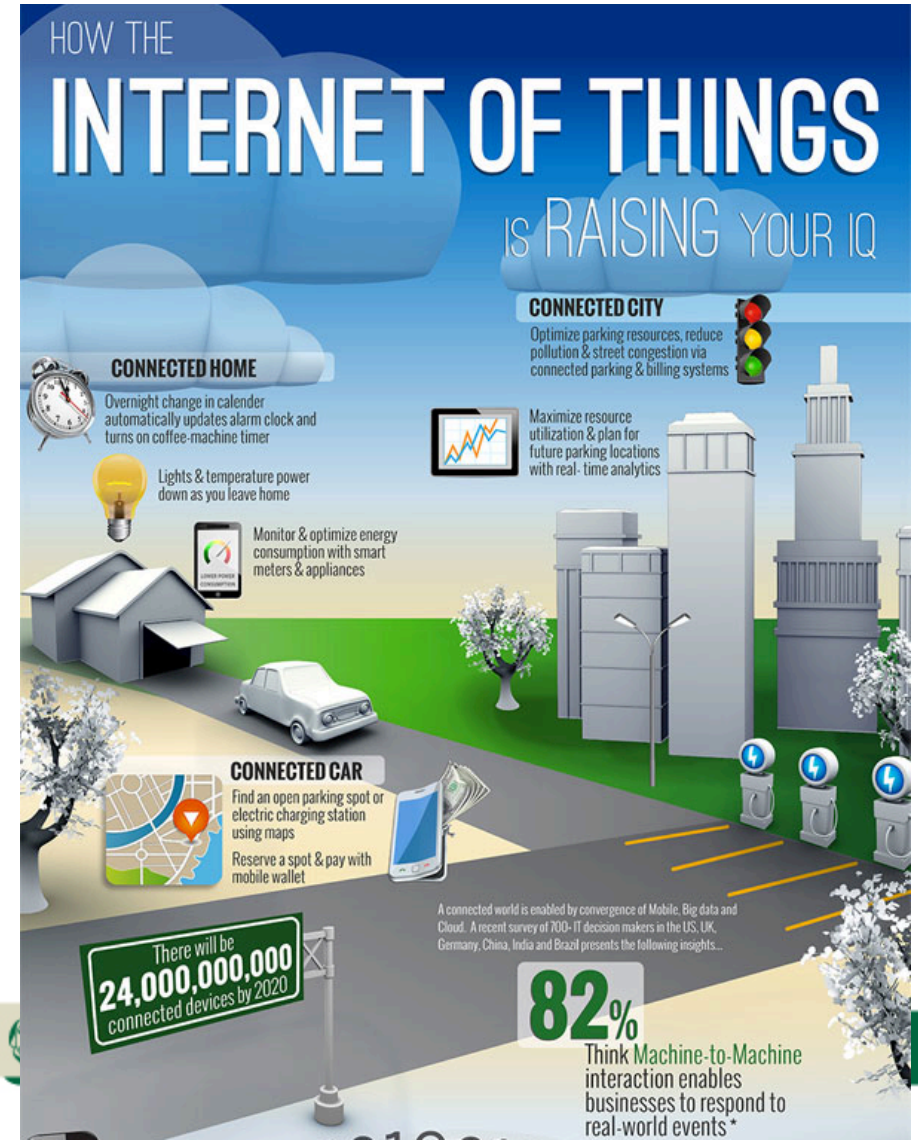
Course Requirements

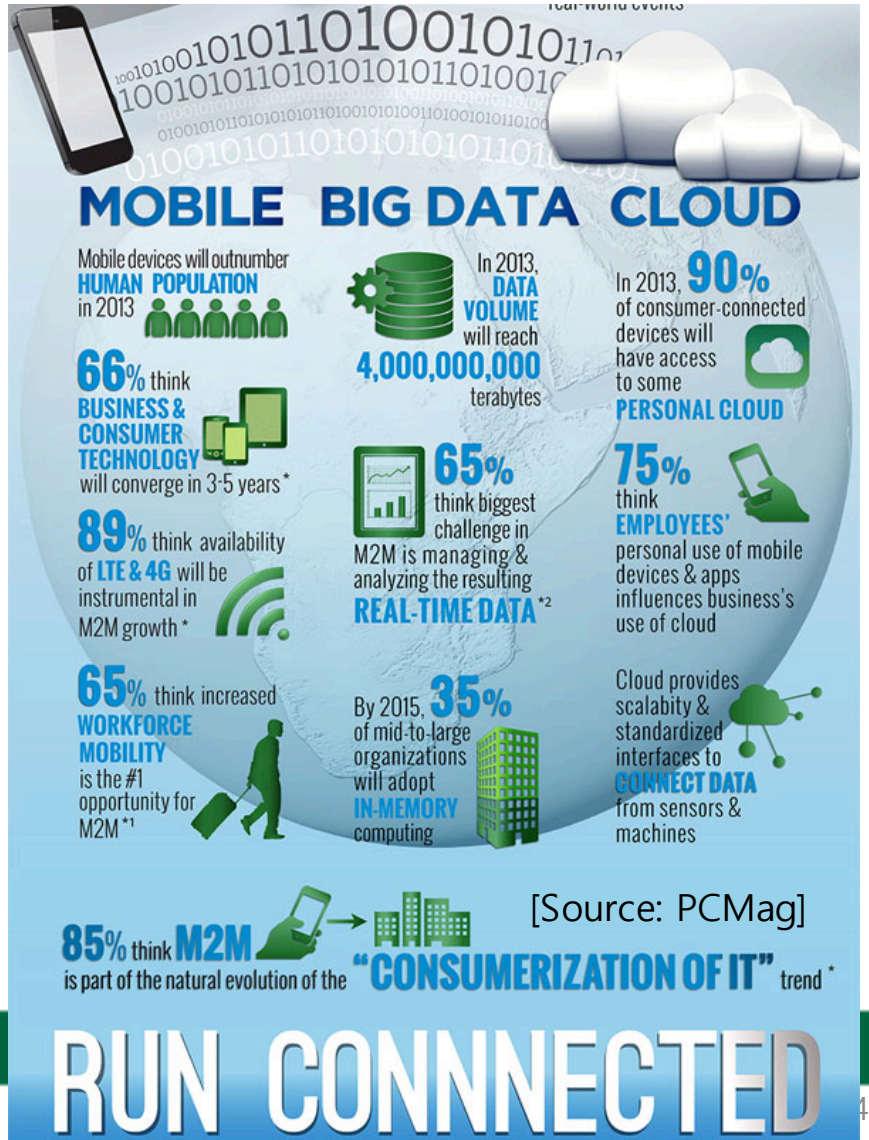
- Lab Assignments (for each lab session)
  - Due on the lab day by 11:59pm
- Homework
  - Setup of your GitHub project repository
- Midterm Exam
- Project
  - Project proposal
  - Presentation & demo
  - Final poster

Assessment and Grade

- Attendance (5%)
- Lab Assignments (15%)
- Homework (5%)
- Midterm Exam (25%)
- Project (50%)
  - Project proposal (10%)
  - Final report (10%)
  - Outcome: source code + presentation + demo (30%)

Internet of Things (IoT): Machine-to-Machine Interaction

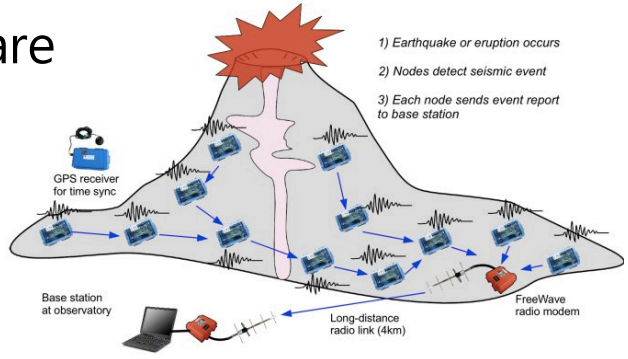


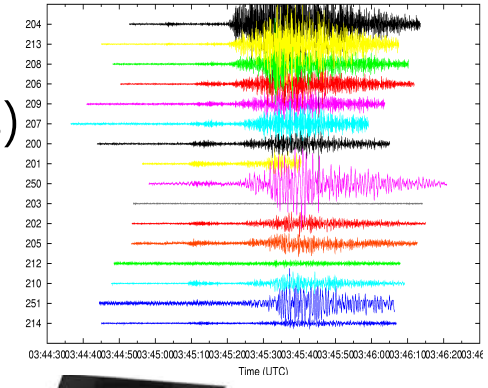


[Source: PCMag]

What is Smart Software?

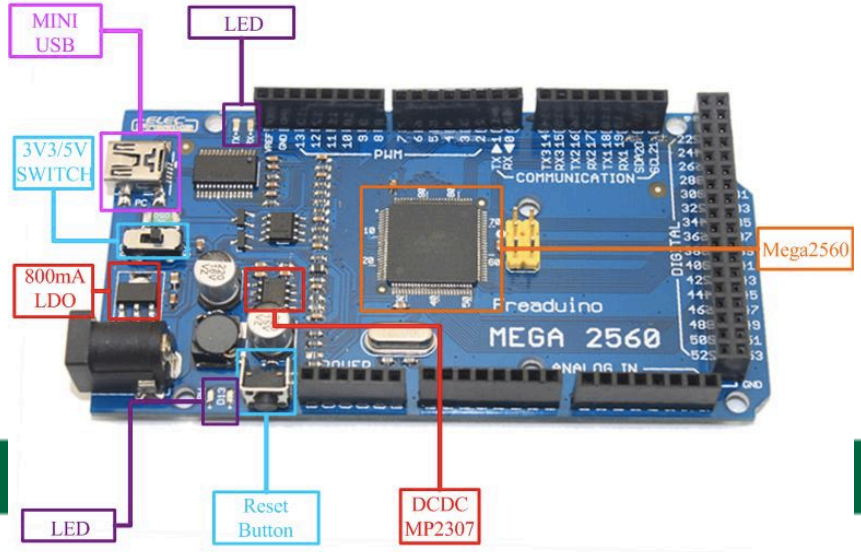
- Smart Software
  - Software with "Intelligence"
  - Flexible and easy usage of various hardware devices
- Then, where is the "intelligence" from?
  - Lots of sensing events in surrounding environments (Big Data)
  - Networking each other (IoT: Internet of Things)
  - Decision making algorithm
    - Machine learning
    - Artificial Intelligence
    - Robotics





What is Arduino?

- Started in 2005 as a project for students
- Founded by Massimo Banzi
- Open-source electronics prototyping platform
  - Open source hardware
  - Assembling/reconfiguring hardware units by hand
- Simple and cost effective development environment (starti ng from $30)
- Easy to upload programs into the microcontroller memory



What is Arduino?

- "How Arduino is open-sourcing imagination" by Massimo Banzi
  - http://www.ted.com/talks/massimo_banzi_how_arduino_is_open_sourcing_imagination.html

Real-World Examples

Twitter Mood Light – The World's Mood in a Box

Arduino R/C Lawnmower

Turn signal biking jacket

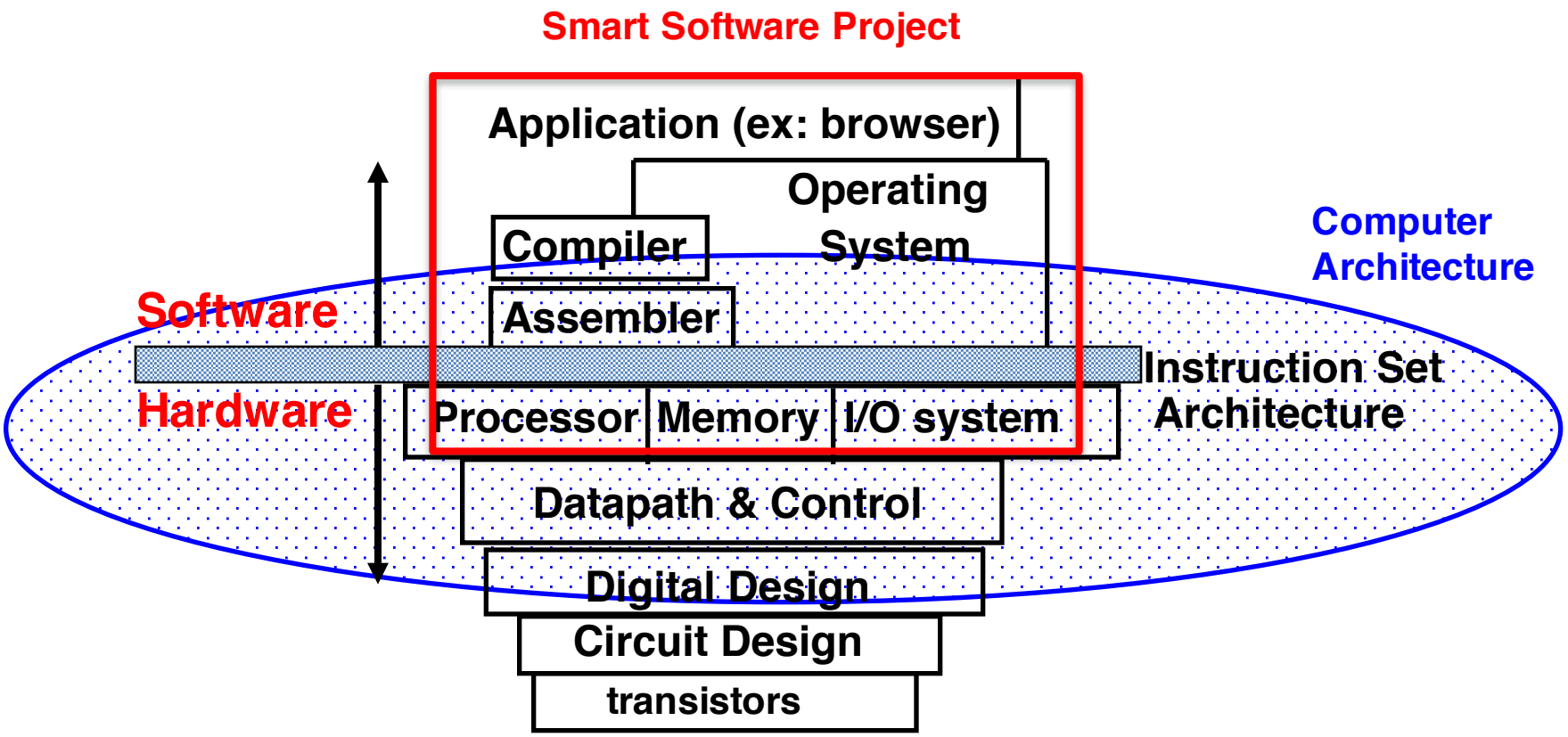
Arduino Quadcopter

From "Back to the Future"

Makey Makey: http://makeymakey.com

Power Laces – the Auto lacing shoe

Smart Software Project



Why do we need to study?

- Who is appropriate for taking this course?
  - CSE students with high motivation on real-world embedded programming
- As a CSE majoring student, you should understand how the whole hardware and software work together
  - You learned this from computer architecture in a low level
  - This course focuses on a little higher level in software
- Embedded programming is everywhere and in high demand
  - Portable devices: smartphone, smart watch, MP3 player, etc.
  - Large systems: hybrid vehicles, traffic light controller, MRI, etc.
- After you take this course, you can now design your own hardware (computing device consisting of customized sensors and devices), and control it with your own software!

Key Questions

- Micro-controller (MCU): ATmega2560
  - Architecture & I/O ports
  - Timers & Interrupts
  - UART control & Bluetooth communication

- Hands-on Arduino programming
  - C based
  - I/O port control
    - LED
    - Motor
    - Bluetooth
    - Ultrasonic sensor
    - Infrared sensor
    - Gyroscope, accelerometer, and compass sensors
  - Software algorithm using the above low-level control

Class Schedule

Week	Lecture Contents	Lab Contents
Week 1	Course introduction	Arduino introduction: platform & programming environment
Week 2	Embedded system overview & source management in collaborative repository (using GitHub)	Lab 1: Arduino Mega 2560 board & SmartCAR platform
Week 3	ATmega2560 Micro-controller (MCU): architecture & I/O ports, Analog vs. Digital, Pulse Width Modulation	Lab 2: SmartCAR LED control
Week 4	Analog vs. Digital & Pulse Width Modulation	Lab 3: SmartCAR motor control (Due: HW on creating project repository using GitHub)
Week 5	ATmega2560 MCU: memory, I/O ports, UART	Lab 4: SmartCAR control via Android Bluetooth
Week 6	ATmega2560 UART control & Bluetooth communication between Arduino platform and Android device	Lab 5: SmartCAR control through your own customized Android app (Due: Project proposal)
Week 7	Midterm exam	
Week 8	ATmega2560 Timer, Interrupts & Ultrasonic sensors	Lab 6: SmartCAR ultrasonic sensing
Week 9	Infrared sensors & Buzzer	Lab 7: SmartCAR infrared sensing
Week 10	Acquiring location information from Android device & line tracing	Lab 8: Implementation of line tracer
Week 11	Gyroscope, accelerometer, and compass sensors	Lab 9: Using gyroscope, accelerometer, and compass sensors
Week 12	Project	Team meeting (for progress check)
Week 13	Project	Team meeting (for progress check)
Week 14	Course wrap-up & next steps	
Week 15	Project presentation & demo I (Due: source code, presentation slides, & poster slide)	Project presentation & demo II
Week 16	Final week (no final exam)	

Class Ethics

- Please respect the instructor and other students
  - Usage of cellphone, KakaoTalk(!), etc. during classes is NOT allowed
- You can discuss your homework assignments with other students, but you should NOT copy solutions from other students (No plagiarism!)
- Missing midterm exam or project will give you 'F'

Notes

- Summary in Korean will be provided at the end of each lecture for 5 minutes
- Questions are always welcome
  - Asking questions in Korean is allowed
  - I will stay for about 10-15 minutes after the class for Q&A
- Late homework submissions will be acceptable up to 3 days with the score penalty of -30%
- iPad will sometimes be used along with laptop

Course Announcement

- Next week, we will cover
  - Overview of embedded and source management in collaborative repository
- Next week, two students will form a team
  - Please feel free to find a team member
  - Otherwise, we can help you to match up with a student
- Hope you would enjoy this course throughout the semester!