EE 579: WIRELESS AND MOBILE NETWORKS – DESIGN & LABORATORY

LECTURE 1

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Department of Electrical Engineering
USC, Spring 2014

Lecture notes and course design based upon prior semesters taught by Bhaskar Krishnamachari and Murali Annavaram.

Instructor

❑ Amitabha Ghosh
  o UtopiaCompression (2012 – Present)
  o Princeton (2010 – 2012, postdoc)
  o USC EE (2010, Ph.D.)

❑ Office Hours
  o 7 p.m. – 9 p.m. Friday, RTH 419 (or PHE 414)

❑ Email: amitabha.ghosh@gmail.com / amitabhg@usc.edu

Teaching Assistant

❑ TA: Suvil Deora
   o Office Hours: 4 p.m. – 6 p.m. Monday
   o Email: deora@usc.edu

❑ All labs must be demonstrated to the TA on the due date provided, exceptions must be requested in advance.

Course Info

Course Page: http://blackboard.usc.edu

Class Time: 6:30 PM – 9:20 PM Tuesday

Course Focus

❑ Design and develop network protocols and applications
- o Wireless and mobile devices
- o Impacts of lower layers on application layer
- o Smartphones, wireless sensors, laptops, …
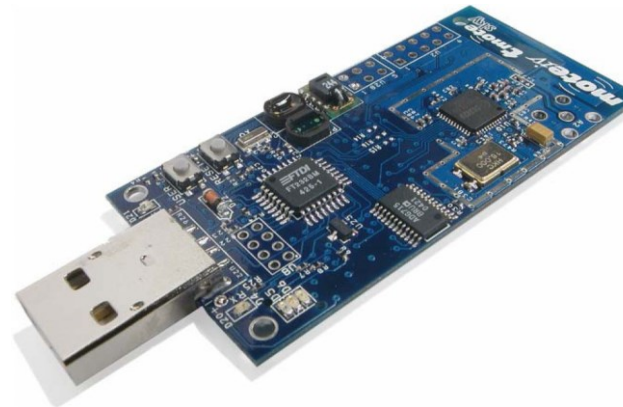
Course Focus

❑ Mobile device architectures / applications / programming
- o Assignments to become familiar with mobile programming
  - Smartphone programming
  - Wireless sensor networks programming

- o Develop final project in a group
  - Must satisfy compelling user need or research goal

❑ Research
- o Read recent research papers on
  - Mobile networks, next-generation radio technologies, sensor networks, …
- o Prepare critiques (~2 pages) and presentation in class

Grading

- ❑ Diagnostic Exam   5%
- ❑ Lab Assignments   30%
- ❑ Written Contributions   15%
  (paper critiques, summary)
- ❑ Mid Term Project Report   10%
- ❑ Final Project   40%
  (report, demo, presentation)

- ❑ Final letter grade will reflect your score on the course relative to others to some extent, but more so on your absolute performance

- ❑ In general: 90 and above an 'A'; 80 and above a 'B'; 70 and above a 'C'

Expected Background

❑ Primarily a hands-on laboratory course (you are on your own for the most part)

❑ Prerequisites
  o EE 555, EE 550 or CSCI 551, CS 402
  o Solid background in programming (C/C++ /Java…)

❑ We (the instructor and TA) are not here to teach you the programming languages, nor debug every issue you encounter

❑ If you feel you would be unable to rapidly pick up and learn one of these platforms on your own (with resources such as websites, forums, books), please drop the course

Individual Labs

- ❏ Lab 1: Smartphone Programming
  - o Details to be announced

- ❏ Lab 2: Wireless Sensor Network Programming
  - o Details to be announced

Final Project

❑ Phase 1
  o Creative project idea using smartphone / sensor resources
  o Pitch your project idea
    • Motivation
    • Development plan and teamwork effort division
    • Phase 2 and Phase 3 demo descriptions

❑ Phase 2 (~3 weeks after Phase 1)
  o Work hard, achieve demonstrable code
  o Submit status write-up, demo to class

❑ Phase 3 (~3 weeks after Phase 2)
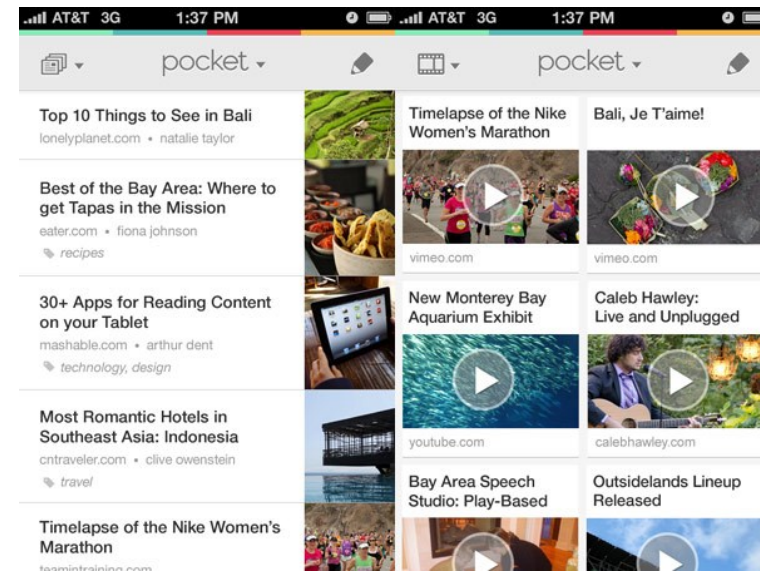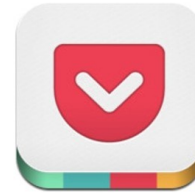 o Final application presentation / write-up / demo

Smartphone Apps

The Good Enough Revolution: When Cheap and Simple Is Just Fine
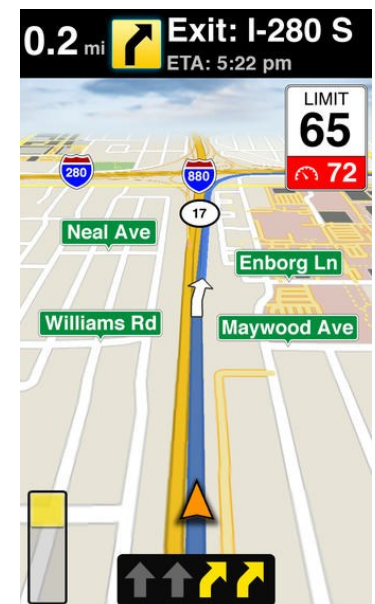*Wired Magazine, Aug 24, 2009*

❑ Pocket

- o When you find something interesting you want to view later, put it in pocket
- o iPhone, iPad, Browsers, …

❑ Car GPS

- o Entry level Garmin $80-$100
- o MotionX GPS Drive
- o 4.4 Stars, $0.99
- o Voice navigation costs

Smartphone Apps

❑ Skype
  o Quality can be sketchy, but
  o Free or VERY low cost, 4+ rating
  o Available everywhere
  o The user experience is uniform

❑ Instagram
  o Social video-shooting and sharing
  o Jazz up photos and videos with filters
  o Change the focus while shooting
  o Free, 4+ rating

Smartphone Apps

❑ Duolingo
   o Apple's top app of 2013
   o Learn a new language
   o Spanish, German, French, …
   o Both visual and verbal lessons
   o Free. Reward points to buy perks

❑ Over
   o Overlay text on images
   o Turn routine pictures into e-cards
   o Price: $1.99

Smartphone Apps

And so many more …

Smartphone: The Swiss Army Knife

- ❑ Applications can be developed at a very low cost, using high end hardware

- ❑ So long as the sensor capability / battery life of the app is "good enough," the cost and convenience trumps

- ❑ The UI of smart phone applications are nearly uniformly easier to understand and operate than other devices

- ❑ Common development libraries for these platforms allows a user experience that is similar between applications and platforms, enhancing penetration into new demographics

Smartphone Platforms

Android (Google)

- ❑ Lot of customizability
- ❑ 1,000,000+ Apps
- ❑ 32 languages
- ❑ 4.4 Kitkat (Oct 2013)
- ❑ Many phones and tablets, including Kindle Fire, LG, HTC, Samsung, …
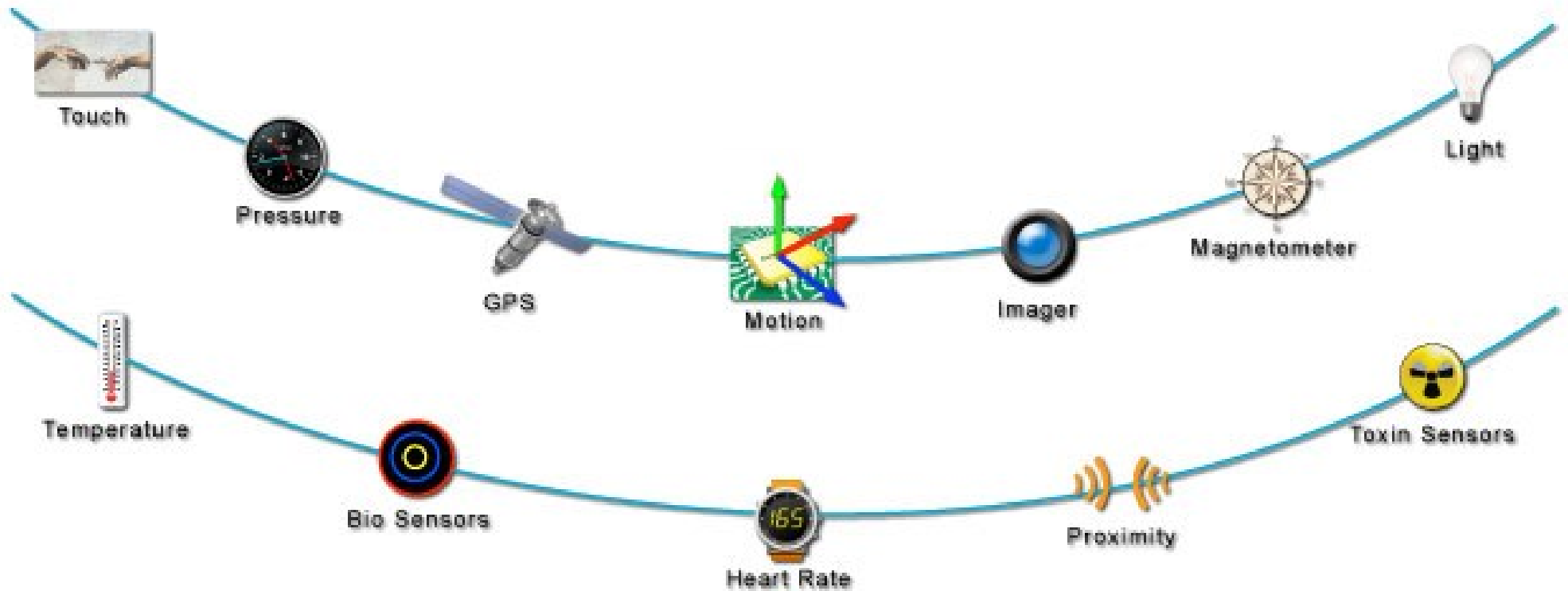- ❑ Google, LG, Samsung, HTC, Sony, ASUS, and many more

iOS (Apple)

- ❑ Limited unless jail broken
- ❑ 850,000+ Apps
- ❑ 34 languages
- ❑ 7.0.4 (Nov 2013)
- ❑ iPhone, iPad, iPod Touch, Apple TV
- ❑ Apple Inc.

Market Share

Normalised share (% of smartphone market)
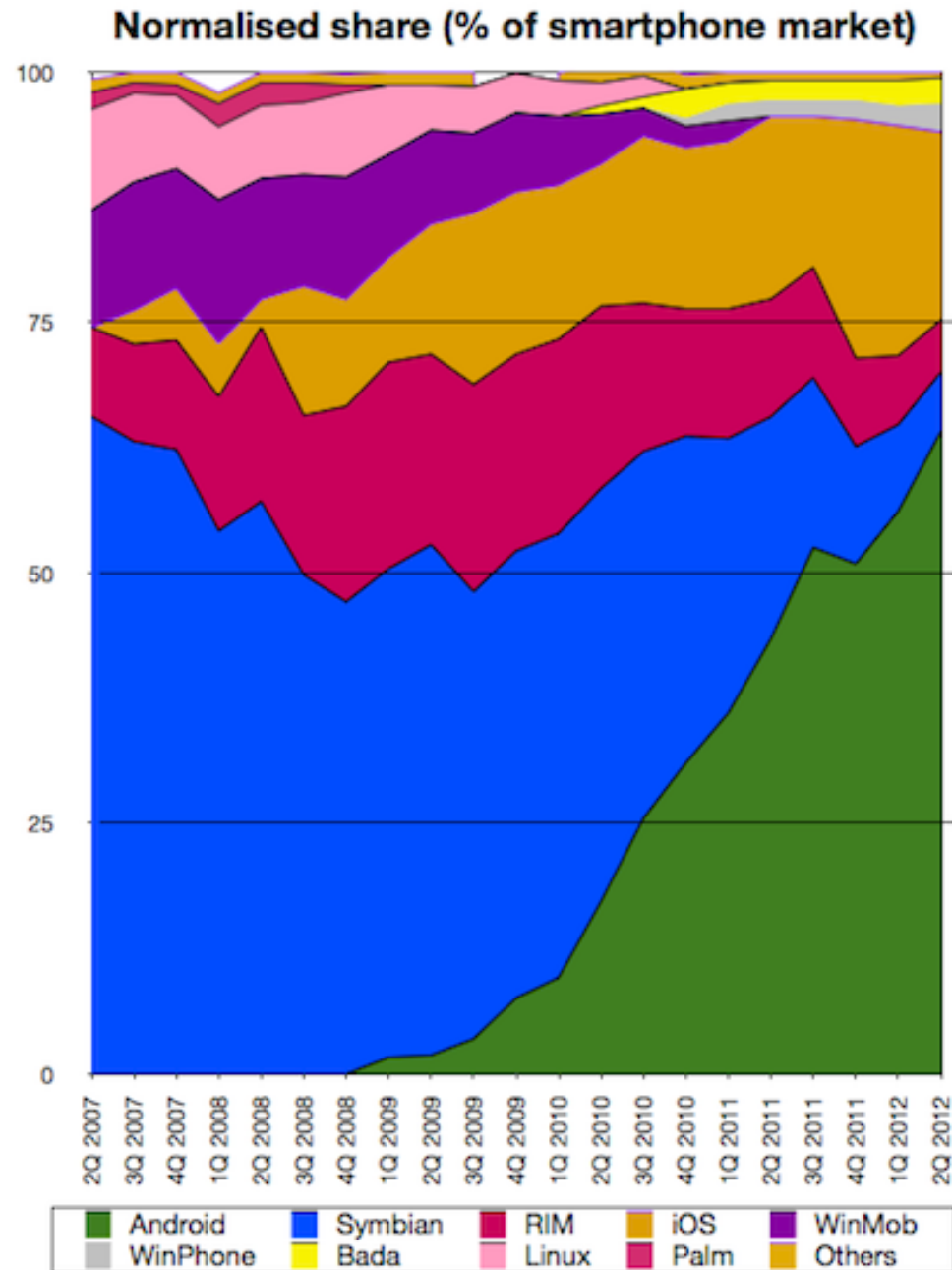
Sensors

Wireless Sensor Platforms

❑ TinyOS

  ○ 1999: UC Berkeley DARPA NEST program. Current version 2.1.2, Aug 2012

  ○ NesC – a dialect of C, optimized for tiny memory

  ○ Software components, some hardware abstractions

  ○ Components are connected using interfaces

Wireless Sensor Platforms

❑ Contiki (v2.7 Nov 2013)

- o Open source OS for the Internet of Things
- o Connects tiny low-cost, low-power microcontrollers to the Internet
- o Written in C
- o Cooja simulator, emulated before burned into hardware
- o Supports IPv4, IPv6, 6lowpan, RPL, CoAP
- o Coffee flash file system
- o Protothreads – event-driven and multi-threaded
- o Runs on a range of low-power wireless devices
- o ContikiMAC sleepy routers
- o Atmel, Cisco, ETH, Redwire, SAP, Thingsquare

What should you be doing this week?

- ❑ Diagnostic Exam
- ❑ Due January 21, 2014
- ❑ http://anrg.usc.edu/~ee652/EE579Diag.pdf