

CG3002

Embedded Systems Design Project

Lecture 1

Overview

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Lecture 1: Overview



Outline

- **Course overview**
 - Course synopsis & objectives
 - Teaching staff
 - Teaching mode
 - Lectures schedule
 - Resources
- **NEW Project overview**

Course Synopsis

This module exposes students to the development of a **large system from conceptualization to its final implementation.**

It is structured to contain substantial design and development of hardware and software components

- **A culmination of theories and practices learned in several modules:**
 - CS1010, CS1020 + CS2010/CS2020, CS2103
 - ✓ **Software Track**
 - CS2007, CG2271
 - ✓ **Hardware Track**

Course Objectives

- **Able to apply hardware and software engineering design principles in specifying, architecting and implementing a complex embedded system**
- **Able to understand team dynamics and successfully manage a reasonably large project**

Motivation - CDIO

- **The CEG degree embodies the CDIO framework**
 - Conceive
 - Design
 - Implement
 - Operate
- **This project aims to be:**
 - Challenging
 - Open ended
 - Solve a meaningful and real problem

Motivation – Real World

- **This project echoes many real world settings:**
 - You have meaningful design decisions to make
 - You need to learn stuff on your own
 - You need to manage the complexity
 - You are cooperating with others to achieve best results
 - You are competing with other teams to "sell" your product
- **A well done project of this complexity will look very good on your portfolio**

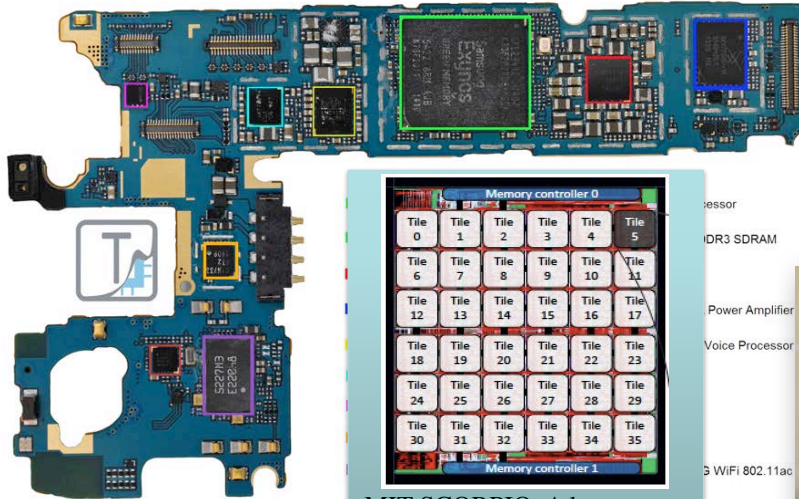
Teaching Staff – The “Human Resource”

- **Dr. Sangit Sasidhar**
 - From ECE
 - Co-lecturer
 - Oversees the hardware aspects
- **Prof. Wang Ye**
 - From SoC
 - Co-lecturer
 - Oversees the software aspects
- **Prof. Peh Li Shiuan**
 - From SoC and ECE
 - Co-lecturer & Module Coordinator
 - Oversees the communications aspect

Teaching Staff – The “Human Resource”

- **TAs**
 - Hw: Ahmad, Boyd, Yuan Ren
 - Comms: Abdelhak, Ayush
 - Sw: Dania, Zhao Na

Intro to me.... *Phone-Driven Transportation*



MIT SCORPIO: A low-power
36-core processor chip
[Daya et al, ISCA 2014]



Phone-based LIDAR
[Gao and Peh, ICRA 2016]

Teaching Mode

- **This is a project module**
 - Not all lectures will be used for teaching new materials
 - No tutorial
 - Lecturer/TA will be present during lab session
 - ✓ You can (and need to) use the lab whenever it is not in session to work on the project
- **This is a 100% CA module**
 - There is no midterm test nor final exam
 - There are multiple check points along the way to encourage consistent effort

Lecture Schedule

Date	Topics
14 th Aug	Course and Project Overview (PLS)
21 st Aug	Introduction to Hardware Platform (SS)
28 th Aug	Communications and Firmware (PLS)
4 th Sep	System Architecture & Machine Learning Basics (WY)
11 th Sep onwards	Miscellaneous

Course Resource

- **Mainly on IVLE portal**
- **Lesson Plan**
 - Will be updated to reflect any changes in schedule
 - Lab activities and deliverables will be indicated
- **Forum**
 - Use for enquiries instead of emails! TAs and Lecturers will be monitoring it
- **Project Grouping**
 - Each group has its own forum and workbin
 - You are encouraged to use it

PROJECT OVERVIEW

Wearables



*Fitness tracking
on Fitbit*



*Here Maps on
Samsung gear s2*



*Pokemon go on
Apple Watch*



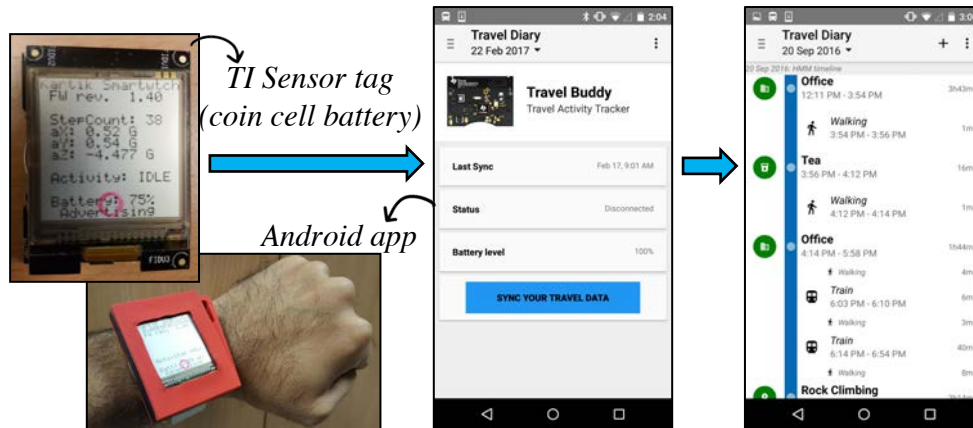
*Health care
apps on smart
watches*



*Navigation
on Google
glass*

Wearables for transport tracking

High-level and personalized travel activity detection on a resource-constrained tag

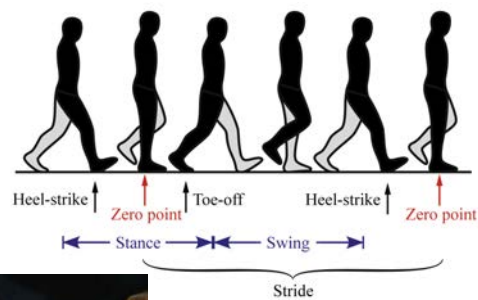


[Peh group's research into wearables for transportation]

Lecture 1: Overview

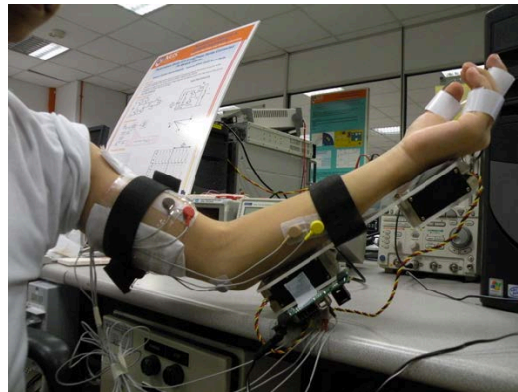
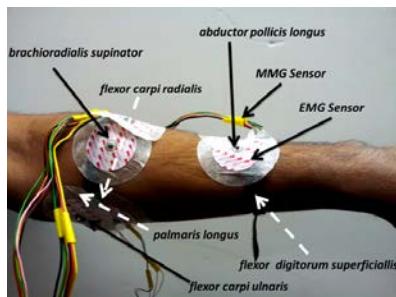


Wearables for healthcare



[Wang Ye group's research into wearables for Parkinson's detection]

Wearables for healthcare



[Sangit Sasidhar group's research into wearables for elderly rehabilitation]

How does a fitness tracker work (at 10,000 feet)?

- **Hardware:**
 - Sensors (accelerometer, step counter, heart rate sensor)
 - Sensor coprocessor
 - Main processor
 - Power management
- **Communications:**
 - Internal communications between sensor and main processors
 - Wireless communications with your phone
- **Software:**
 - Algorithms for distinguishing between idle and steps, learning your sleep pattern, etc.

CG3002 Project: Activity Tracker

Problem Statement:

A wearable device that automatically detects human activities

Fun Problem Statement:

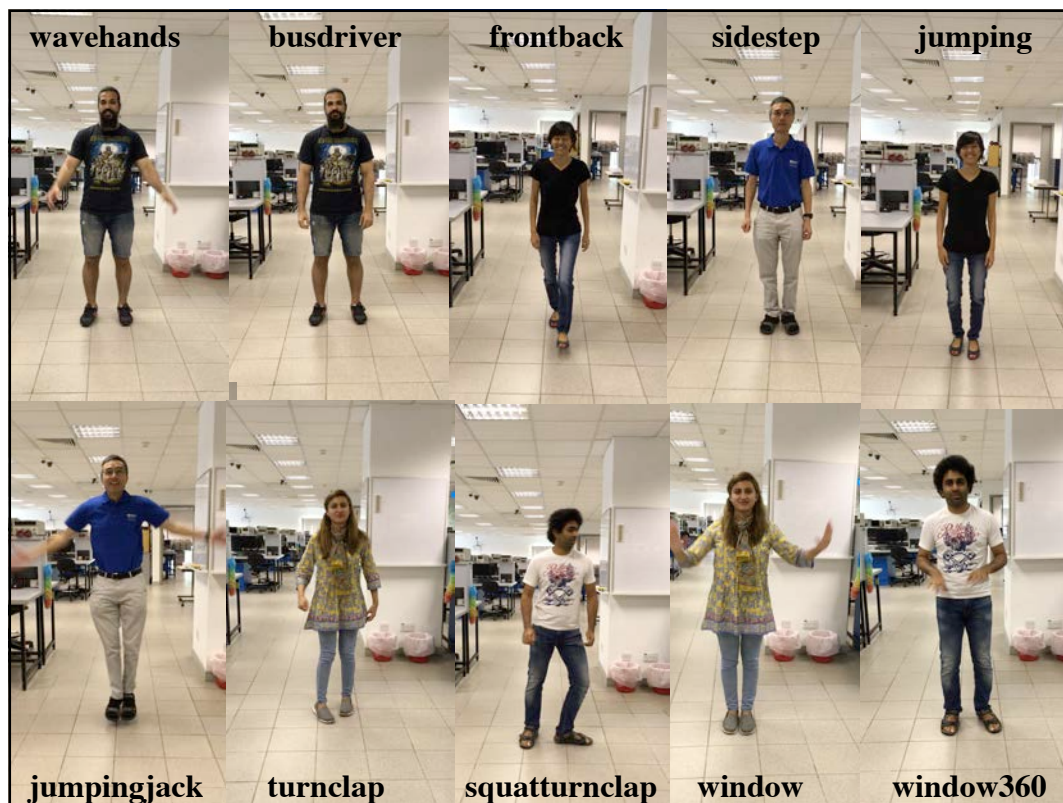
Dance Tracker:

*A wearable device that automatically detects **dance moves***



Dance move videos on IVLE ☺

Dance moves
wavehands (Wave both hands up in the air)
busdriver (Hands moving an imaginary steering wheel)
frontback (Walking front and back)
sidestep (Alternately gliding left leg to the left, then right leg to the right)
jumping (Jumping up and down with hands by the side)
jumpingjack (Doing jumping jacks)
turnclap (Turn 360 degrees and clap)
squatturnclap (Turn 360 degrees while squatting low, and clap)
windowcleaning (Make circular moves with both hands in front)
windowcleaner360 (Window cleaning while body turns 360 degrees)



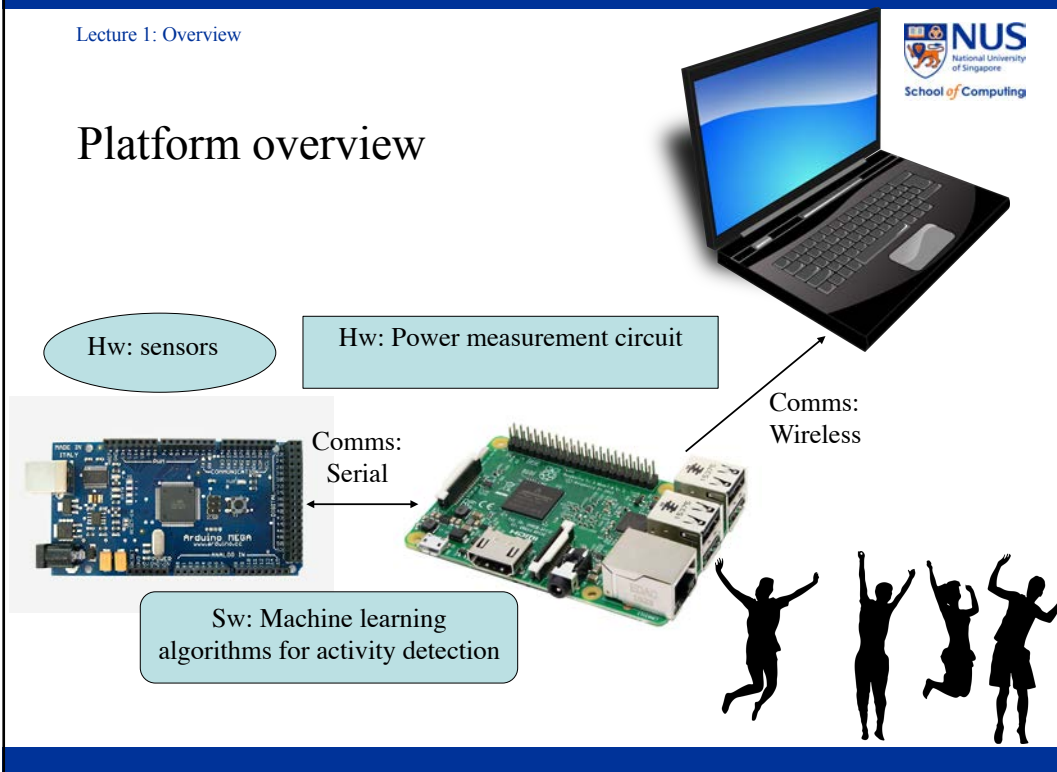
Design your own move!

- **Final move**
- **Neutral position**

Requirements

- Wearable
- Automatic detection
- Works for anyone
- Secure communication of detected moves with server
- Low power

Platform overview



Evaluation metrics

- **Performance: Accuracy, Speed**
- **Power: Battery**
- **Design: Aesthetics, comfort, weight**

Course Schedule (on IVLE)

- **Form groups**
- **First Lab**
 - Friday lab session: August 25th (as Sep 1st is a public holiday)
 - Thursday lab session: August 31st
 - DSA Lab
 - Dr Sangit Sasidhar will be giving a walkthrough of the hardware components and platform

Milestones

- **Week 4: Design report**
- **Week 5: Feedback on design**
- **Week 6: Progress checkpoint**
- **Week 7: Individual components (hw, comms, sw)**
- **Week 11: Baseline evaluation (5 moves)**
- **Week 13: Final evaluation (all moves)**

Design Report

- **Section 1: System Functionalities**
- **Section 2: System Architecture**
- **Section 3: Component Interactions and Design**
- **Section 4: Hardware Details**
- **Section 5: Project Management Plan**

Q&A