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CG3002 Embedded System Design Project
AY 2017/18 Semester I
Project Specification (Overview)

Welcome to CG3002, the capstone project (aka weekend burning, lab camping, crazy final project) for the CEG programme. This project module is meant to challenge your creativity, knowledge and skills to the extreme, i.e. it is going to be very demanding! Be prepared for head-scratching confusions, wall-banging frustrations, but also jumping-up-and-down eureka moments ahead. You have been warned. ☺

For a start, we will give an overview of the project specification. Instead of dumping a whole lot of information on you, this document gives you only an overall picture with limited detail. We will dish out information at the right moment in the upcoming lectures.

There are two sections in this document:

1. Specification overview
2. Timeline of evaluations and milestones

Section 1: Specification Overview

Wearables provide an avenue for detecting human activity automatically, and have been used in wide-ranging scenarios. Fitness tracking is likely the most prevalent use of activity detection. Using wearables such as smartwatches or fitness trackers, users can monitor their step count, as well as more advanced sports training such as stride and pace for running, strike force for tennis, stance for basketball etc. Activity detection has also been used in medical scenarios, such as detecting falls or anomalous movements that indicate medical conditions. In our daily life, activity detection has been applied to infer our minute-by-minute activities at home, during commute, at work or school, while shopping, exercising, etc.

In this project, the goal is simple – design a wearable device that can detect specific human activities automatically.

Problem Statement:
A wearable device that automatically detects human activities

To make it more fun, each activity will correspond to a dance move, so you can get a dance workout while working on the project!

Main requirements:

- Wearable: The device must be a wearable worn on the human who is performing the activities. All sensing and compute must be done on this wearable. Weight, form factor and comfort are all potential evaluation criteria.

- Wearable automatically detects these dance moves (Check out videos of dance moves at class)

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)

- The wearable should work when worn by anyone.

- By performing the specific activities, the wearable detects the dance move and communicates the detected dance move to the class server in a secure manner (The interface with the server will be published)

- Server will indicate random dance moves in turn, then the individual will perform the dance move with the wearable system, and the system will be evaluated to see if it has correctly recognized the specific dance move.

- You should design a final move that will trigger your system to send a “the end” message to the server indicating the end of the dance routine.

- The system must include a power measurement circuit that measures the power consumed by the wearable system. The power consumption will be communicated to the server as well and used as a metric for evaluation.

- Hardware platform:
    - A Raspberry Pi 3 mini computer
    - An Arduino mega board
    - A set of standard sensors
    - 50SGD budget per head (i.e. 300SGD for a group of 6 persons) for additional items

- The system will be evaluated based on performance, power and design. Performance refers to detection accuracy – whether dance moves are detected correctly, and detection speed – how fast each move is detected, measured from when the server displays the specific move to when the message with the detected move is received at the server. Design refers to aesthetics, comfort, weight, etc.

Total (and scary) Design Freedom:

Most aspects of the project are open:

- Sensors Input: What kind of sensors will you use to detect each move and differentiate amongst the moves?

- Algorithms: How will you learn and disambiguate amongst the different moves and handle different individuals?
- Power measurement hardware: What circuits will you use to measure the power consumed by your system?

Section 2: Timeline of evaluations and milestones

The project has the following milestones:

1	**Overall System Design** Design the high-level system architecture. Figure out the interfaces between subsystems. A good design allows each subsystem to be developed and optimized independently.
2	**Individual Subsystems** Develop the subsystems concurrently. By adhering to the designed interfaces, the subsystems should be able to work together in the next phase.
3	**Integrated System** The subsystems are integrated and works as a whole. Fixing integration bugs is the main focus in this phase.
4	**Baseline System** The integrated system is working well and meets the baseline requirements as given below: 1. Measures power of system 2. Detects the first 5 moves 3. Communicates the moves to the server securely
5	**Final System** The integrated system works well for the full project specs: When given a sequence of specific dance moves, the user performs each move in turn and the system detects and communicates the moves to the server.

The evaluation timeline follows closely the milestones given above. The criteria of each evaluation will be clarified at the appropriate time. Note that the schedule and evaluation criteria may be adjusted depending on the cohort's progress as a whole.

Week	**Evaluation**
4	**Design Report: (10%)** - Overall system design - High level subsystem design - Independent research describing prior art and explaining proposed design - Submission to IVLE workbin (by September 8th) - Feedback will be given in week 5's lab sessions (September 14/15)

6	**Progress checkpoint: (5%)** - Ensure team is on the path for 1st prototype - Ensure team reacts to feedback from design report. - Checked during lab sessions (September 21/22)
7	**1st Prototype Evaluation: (15%)** - Subsystems may not be integrated - Subsystems will be evaluated independently - Criteria will be given - Evaluated during lab sessions (October 5/6)
11	**2nd Prototype Evaluation: (30%)** - Subsystems must be integrated - Based on Baseline requirements as stated in the milestones - Evaluated during lab sessions (November 2/3).
13	**Final Demo: (40%)** - Based on Final system requirements as stated in the milestones - Evaluated during lab sessions (November 16/17).