CG3002 Embedded System Design Project
AY2014/15 Semester I
Project Specification (Overview)

Welcome to CG3002, also known as the **capstone project** for CEG students. This project module is meant to challenge your creativity, knowledge and skills to the utmost, i.e. it is going to be very challenging! 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 you 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 details. 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

Consider this ***user story***: Cylis is a woman in her 50s. She suffers from cataract since her early 40s. The illness has rendered her practically blind now. With the help of her trusted walking cane and Naal, her guide dog, Cylis has no problem travelling to many of her favorite places in the city. However, navigating in a building poses a huge problem for her. Firstly, many buildings disallow guide dog. Secondly, it is hard for her to traverse through the maze-like interior to get to her destination. Is there anything we can do to help Cylis and many others like her?

As engineer, it is well within our capability to tackle these problems and come out with a practical and clever solution. So, here's our problem statement:

Main Theme

A wearable device to provide in-building navigation guidance for a visually-impaired person

Main requirements:

- **Wearable.** Example: A cap, backpack, belt, walking stick etc. Weight, form factor and comfort are all potential evaluation criteria.

- **Provide path navigation.** Figure out the path from one point in the building to another and guide the wearer to walk toward the specified endpoint.

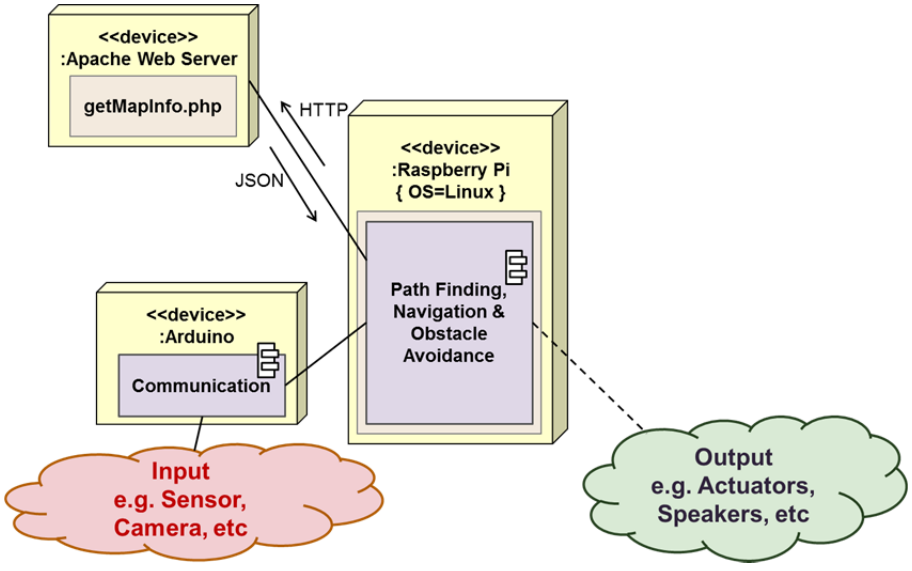
- **Obstacle avoidance.** Guide the wearer to avoid obstacle along the way. Obstacles may be static and or moving. Elevation detection may be needed to handle staircase, uneven ground, hole in the ground, etc.

Currently known information:

- There are several end points in a building to represent possible destinations.
  - Each end point will have a unique id for simplicity.
  - The wearer will specify the unique id of the starting and destination end points.
  - Building floor plan can be retrieved through internet.

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

Although you have almost limitless ways to build the device, there are a couple of "core components". Essentially, the system can be visualized as follows:



Total (and scary) Design Freedom:

Most aspects of the project are open:

- **User Input:**
  - The endpoint can be specified through keypad, voice command etc.
  - Other input method: Keyboard? Touchscreen?

- **Sensors input:**
  - Obstacle sensors: Infrared? Ultrasonic? Camera?
  - Navigation sensors: Gyroscope? Compass? Accelerometer?
  - Additional sensors can be acquired to augment / expand your standard sensors set.

- **Power consumption:**
  - How do you conserve battery power?

- **Guidance command output:**
  - Can be provided by actuators (vibration), speaker (speech) etc

- **Algorithms:**
  - Algorithms for path finding, navigation, obstacle avoidance, sensor filtering etc are not fixed.

Section 2: Timeline of evaluations and milestones

Essentially, 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 meet all the baseline requirements as given below: 1. Read and interpret floorplan data from server. 2. Simple path finding, i.e. no • Only on single floor, i.e. no staircase. 3. Simple navigation • Path has very few turns. 4. Static obstacle avoidance, e.g. wall.
5	**Final System** The integrated system goes beyond the baseline requirements given above. Each aspect will be evaluated separately: • Path Finding • Navigation • Obstacle Avoidance • Form factor The exact weightage assigned to each aspect will be disclosed no later than milestone (3).

The evaluation timeline follows closely on 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 designs
6	Progress checkpoint: (5%) - Ensure team is on the path for 1st prototype - Ensure team reacts to feedback from design report.
7	1st Prototype Evaluation: (20%) - Subsystems may not be integrated - Subsystems will be evaluated independently - Criteria will be given
11	2nd Prototype Evaluation: (25%) - Subsystems must be integrated - Base on **Baseline** requirements as stated in the milestones -
13	Final Demo: (40%) - Base on additional/advance features

Note that for the second prototype evaluation and final demo, we will test your device in the actual setting (i.e. navigating in a building).