EA2.3 Electronics 2

Team Project Specification – The Dancing Segway

Peter Cheung, v2.3

AIM

To demonstrate your understanding of four topics in the Electronics 2 module that are important to design engineers: 1) signal processing; 2) system analysis and design; 3) feedback control; 4) real-time embedded system.

EARNING OUTCOMES

At the end of the project, you should be able to:

- **Process music signals** using signal processing techniques to extract its signal characteristics such as rhythm (e.g. beat), spectral contents (e.g. colour) and mood (e.g. swinging, loud, quiet);
- Creatively map the music characteristics to dance routines;
- Analyse music signals in real-time on the microcontroller to **synchronize** dance movement to music;
- **Balance** a mini-Segway using a PID controller so that it moves around on two wheels under the control of your phone;
- Implement the mini-Segway that autonomously dance to live music.

TEAM PROJECT

Students will work in groups of four to design and build the embedded program for the mini-Segway to achieve the final goal.

The project provides scopes for students to:

- apply what they have learned in this module to a realistic problem;
- learn to combine offline processing using Matlab with real-time processing using MicroPython;
- apply embedded system concepts and techniques such as sampling, buffer, interrupts, scheduling etc.;
- have fun!

Assessment for the Group Project will consist of:

- Presentation by each project team to an assessor in the morning of Wednesday 18 March 2020
- Take part in a "Coming Dance" competition and showcase each team's design

This component is worth 20% of the module, 10% is team mark which is the same for all members of the team, and 10% is determined by Peer Assessment with WebPA.

TEACHING STAFF

Module Leader: Professor Peter Cheung, Professor Bob Shorten
GTAs: Ian McInerney, Pietro Ferraro, Andrew Cullen

ORGANISATION AND STRUCTURE

There will be 25 teams, each team has three students. Teams are encouraged to choose their own team partners.

Each team is provided with a car chassis and a PyBench boards. The PyBench board is a purpose-design piece of hardware that includes: a ARM microcontroller (the Pyboard), an OLED display, a microphone with auto-gain amplifier, a Bluetooth to UART interface module, an IMU, a dual-motor driver, a DC-DC converter and a potentiometer.

Five individual experiments were designed to help students learn about the course module and devices included on the PyBench board. By the time students start their Team Project, each would have been familiar with the theory and usage of both hardware and software required to complete this project.

MILESTONES

1. **Detect Beats and flash LEDs** – To analyse the music using the microphone on the PyBench and detect when the beat occurs. Flash LEDs to indicate beats.

   Target completion date: 19th Feb.

2. **Control of the Segway** – To fit a pair of "stabilizers" to the two-wheel chassis so that the vehicle will not fall over, but have enough clearance to implement self-balancing later. To drive the Segway with stabilizer along a defined path under the control of the mobile phone connect to the PyBench via Bluetooth.

   Target completion date: 26th Feb.

3. **Simple Dance with stabilizer** – To analyse the music of your choice and create a simple dance routine, transfer to the PyBench to store on the SD card and write a Python program on the PyBench to control the Segway with stabilizer so that it moves to music.

   Target completion date: 4th March.

4. **"Come Dancing competition"** – The final assessment will involve demonstrating the dancing Segway that synchronizes to life music, while balancing on two-wheels. Assessment will be based on the robustness of the vehicle, the creativity of the dance routine, the quality of the synchronization to the music etc.

   Final assessment of the Team will take place on: Wednesday 18th March.