

# DANCING SEGWAY PROJECT

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Video documentation of the project impaired by breakage of stabilisers during testing, and the LIPO running out of charge, hence all milestone demonstrations attempted using 5V power.

## 1 MILESTONE 1: COMPLETE

Real-time beat detection utilising interrupts to accurately report local energy peaks in music. Initial evaluation focussed on offline processing of an audio signal in MATLAB to determine tempo and character.

Audio input sampled until 64 samples have been acquired. Energy of this period is calculated and stored in a 16-element buffer, which is used to calculate an average to which the current energy is compared. If this exceeds a threshold, ie the energy of the most recent sampling period is significantly higher than the average across the last sixteen periods, the LED flashes.

## 2 MILESTONE 2: COMPLETE

Remote bluetooth drive using Adafruit module to receive UART communication from user's phone.

Polls for 10-bit UART command from the control pad. If a valid drive command (U,D,L,R), the relevant motor speeds are incremented or decremented by 10% duty cycle. This means speed and direction of the segway can be controlled remotely.

## 3 MILESTONE 3: COMPLETE

Comprehension and execution of a variable-length ASCII dance routine in sync with live music.

Using beat detection as in Milestone 1, single-beat dance moves are read from a .txt file, decoded into direction commands and speeds, and 'danced' by the segway. Dance evidenced in video is a particularly dull test and not inspired by the song due to time and COVID-19 limitations.

## 4 MILESTONE 4: COMPLETE

Angle rectification using PID control to minimise oscillation and error accumulation to self-balance.

Polled-error PID controller with real-time tuning that recalculates error angle each call and adjusts correction in proportional, integral and differential control respectively. Initial investigation suggested PID control would be too long to code as an ISR, however further evaluation would be necessary to confirm this.

For backwards compatibility with the previous milestones, UART commands and dance moves are modified to lead to adjustment of the set point by 5 as opposed to modifying PWM control.