**AINT308: Computer Vision and Behavioural Computing**

**Phil Culverhouse**

**Overview**  
Students will learn how to (a) actuate servos to control the OWL robot using the Raspberry Pi , (b)  learn how animals use vision to interact with the world, (c) how to use OpenCV to implement visual routines to make the OWL robot behave like an animal and (d) review complex vision recognition in current commercial toy robots.

**Assessment**

There are two assignments, the first is worth 40% of the module mark, the second 60%. Both require that you control the servos to provide smooth control with image video evidence. The reports must be well written with good use of English. To gain first-class marks you will need to consider animal vision systems in your report, including useful references to books, academic papers and web resources. Your videos must be short and demonstrate

**Assignment 1 – 40% of module mark**

Deadlines end February – see DLE for details. Submit report to DLE.

Control servos to do the following:

* + 1. Neck control to pan head in a sinusoidal manner
    2. Eye control from host computer (key press selection)
       1. Show stereo control by mirroring PWM to both eyes and scan horizontal axis at a plausible rate
       2. Show chameleon like eye motion for 10 seconds
       3. Show two other behaviours that mimic human or animal emotive eye motion

**Assessment**: Report detailing the achieved PWM sequences, code snippets and flow charts. Provide small video snippet OR link to YouTube video. Discuss in relation to animal equivalents (references required for good marks). Recordings of live video from each motion will support a higher score, if they demonstrate robust stable vision.

Marking scheme:

1. Video 25%
2. Report: background on animal systems 25%
3. Achieved PWM sequences, code snippets and flow charts 25%
4. Code snippets: quality, extent and commentary 25%

Total: 100% == 40% module mark

**Assignment 2 – 60% of module mark**

You will need to use a Smeaton 302/303 laboratory computer and an OWL robot for the coursework. Note that MACs may not be a viable platform due to the lack of MJPEG streaming.

* + Deadlines mid-April; see DLE for date. Submit report via DLE.
  + Stereo vision software & eye control
    - 10% Using simple Cross-correlation & Servo control
      * Verge onto a target ensuring eye symmetry, give estimate of distance
      * Track target for 10 seconds
    - 20% Using Homography in OpenCV & servo control
      * Calibrate cameras in orthographic mode
      * Take static images, calculate disparity of a target
      * Produce depth map, demonstrate calibration against ruler
    - 40% Using bottom-up Saccadic stereo eye control develop a processing model, and apply it to process a scene. The model should Saccade to salient targets, acquire images, map distances to targets
    - 20% Report on all above, with references and comparisons between machine and animal stereo systems
    - 10% Review available computer vision-based toys and compare to your OWL design.
  + Note: expected effort is in percent.

Marking scheme:

1. Video/demonstration 25%
2. Report: background on animal/human systems 25%
3. Achievements, robustness of tracking, code snippets and flow charts 25%
4. Code snippets: quality, extent and commentary 25%

Total: 100% == 60% module mark

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**Referred assessment – 100% of module mark**

This is essentially a repeat of the second coursework assessment of the module. You will need to use a Smeaton 302/303 laboratory computer and an OWL robot for the coursework. Note that MACs may not be a viable platform due to the lack of MJPEG streaming.

Please make arrangements, as early as you are able, to use these resources.

* + Deadlines mid-August; see DLE for date. Submit report via DLE.
  + Stereo vision software & eye control
    - 10% Using simple Cross-correlation & Servo control
      * Verge onto a target ensuring eye symmetry, give estimate of distance
      * Track target for 10 seconds
    - 20% Using Homography in OpenCV & servo control
      * Calibrate cameras in orthographic mode
      * Take static images, calculate disparity of a target
      * Produce depth map, demonstrate calibration against ruler
    - 40% Using bottom-up Saccadic stereo eye control develop a processing model, and apply it to process a scene. The model should Saccade to salient targets, acquire images, map distances to targets
    - 20% Report on all above, with references and comparisons between machine and animal stereo systems
    - 10% Review available computer vision-based toys and compare to your OWL design.
  + Note: expected effort is in percent.

Marking scheme:

1. Video/demonstration 25%
2. Report: background on animal/human systems 25%
3. Achievements, robustness of tracking, code snippets and flow charts 25%
4. Code snippets: quality, extent and commentary 25%

Assessed Learning Outcomes

* Demonstrate understanding of the underpinning vision theories
* Demonstrate understanding of the current theory and practice in object recognition
* Design and implement a practical vision application

Total: 100% == 100% module mark