PHAS3441 PHYSICS GROUP PROJECT 2015/16

Project Brief:

The Development of a Sand Art Drawing Robot

The Challenge:
The challenge is to develop a robot which can draw artwork on sandy beaches.

Group arrangements:
Although, it is up to the group to decide how to break down the work between its members, the following approach is suggested:

1. Aims and motivations
Sand art can be considered a genre within what is termed “Land Art”, “Environmental Art” or “Eco Art”. An art review should be undertaken to appreciate the context of this project and the group should determine:

a) What is this project for?
   i.e. what should be the underlying purpose and motivations:
   education, entertainment, therapy, business opportunities, advertising, campaigning, art for art’s sake, etc.
b) What should the robot draw?
c) An appropriate name for the robot.

2. Literature review: History of robotics
A literature survey should review relevant historical developments, including:

- The autonomous tortoise robots of William Grey Walter (neurophysiologist and robotician) first developed in the late 1940s
- The 1980s BBC microcomputer turtle drawing robot programmed using Logo
- Micromouse maze navigating robot competitions
- The development of Mars rover vehicles
- Beach art robots

The literature survey should also review the advantages and disadvantages of various drive and steering mechanisms using, for example, wheels and caterpillar tracks, as well as possible drawing mechanisms.

3. Developing a specification
Consider:

- Scale of artwork required
- Possibilities for a small-scale test-ground sandpit and alternatives such as drawing with chalk on tarmac or paint on grass
- Small design to be easily transported and carried on public transport by one person
- Designing robot to fit in a specific suitcase or rucksack
- Locations of sandy beaches
- Compliance with Health and Safety, and other appropriate legislation and regulations

4. Mechanical Design and Construction
For the mechanical design, it may be helpful to construct a number of prototypes using readily available materials such as cardboard and tape, or construction kits such as Lego, Meccano or K-nex. To save on materials, scale-models could initially be built.

The group will need to determine what materials to use to construct the “chassis” or “body” of their robot and the movement mechanism. The group have the option to utilise any of the hardware components "left-over" from previous robotic projects.

5. Actuators and electronic interfacing
Possible actuators for implementing the drive, steering and drawing mechanisms include: geared DC motors, stepper motors, servo motors, hydraulically-operated devices and pneumatically-driven air muscles. Electronic circuitry will be required to interface with the actuators.

6. Software Design
Robotic control could be implemented using "Arduino" (www.arduino.cc) and/or "Raspberry Pi" (www.raspberrypi.org) development boards.

7. Guidance systems
Should the robot be under wireless guidance and control by a human and/or autonomous? Guidance mechanisms could include: tethering, guide ropes, GPS, ultrasound or laser scanning of marker posts.

8. Modelling
Prototypes can also be constructed “virtually” using various CAD programmes, or “game development” software. Further insights may also be gained by producing “animations” of any scale-model prototypes developed, using “stop-frame” video techniques.

9. Website development
The group is required to produce a website to document the design process from conception of prototypes to final implementation, and host a video of their robot in action completing the challenge. The group may also like to consider using various social media.

Further information:
https://en.wikipedia.org/wiki/William_Grey_Walter
http://www.extremenxt.com/walter.htm
http://www.beachbot.ch/

Websites for “Arduino” and “Raspberry Pi” products:
www.maplin.co.uk
uk.farnell.com
uk.rs-online.com

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10 January 2016