Student project:

Cyborg plant: towards plant robot adaptation

Abstract

We are calling for a student who is motivated in working in robotics field specifically with plantoid (robot and biological plant) to achieve plant cyborg as his/her (i) Bachelor thesis (ii) semester project / internship. (If you are interested in working on this as a (iii) master / diploma thesis, please tell us your concrete requirements).

Here we provide two topics on the study of plant cyborg on (1) **plant – robot communications** and (2) **plant prosthetics**. Please take a look at the following research topics and feel free to ask us further details.

1. Cyborg plant?

What do you think would happen if you had a biological plant and an artificial plant in the same pot? will they compete? or will they adapt to one another? Plant is known for its amazing adaptability. Depending on the environment, they can adjust their morphology as well as its dynamic states as a whole – by regulating its genes expression - while in robotics, namely artificial technology, the product is lacking regulatory capabilities such as self-repair or self-healing. In our project, we focused on these advantages and investigate the possibility of cyborg technology between robotics and plant biology, to gain novel insights on robotic morphology design, principles of adaptation among biological and artificial entities.

2. Initial attempt: Avocado-bot

a)   b)

The shown picture a) is the first developed research platform. The system consists of a plant Avocado, and two inclination sensors for the detection of the tilt of its leafs, and automatic water supply to give a feedback to the plant. In b), picture of a preliminary plant prosthesis is shown. The inability of the plant is induced by setting stress (heat, drought) in the plant's environment. The idea is to observe the cooperative reaction of the plant and exploit robot technologies to enhance the adaptability.

3. What can you learn?

Knowledge and skills of robotics (designing the parts with a CAD soft and a 3D printer, learning basics of microchip for the controlling motors).

4. Your major?

Having your major either in engineer or biology is ideal. Especially those who want to do something unconventional with robotics are highly welcome (such as electrical engineer, biologist, mathematician, physicist).

5. Reference

Dana D. Damian, Alejandro Hernandez-Arieta, Max Lungarella and Rolf Pfeifer (2009) An Automated Metrics Set for Mutual Adaptation between Human and Robotic Device (ICORR), Kyoto Japan

Topic 1: plant – robot communications (plant robot communication for ecosystem of biological and artificial plants)
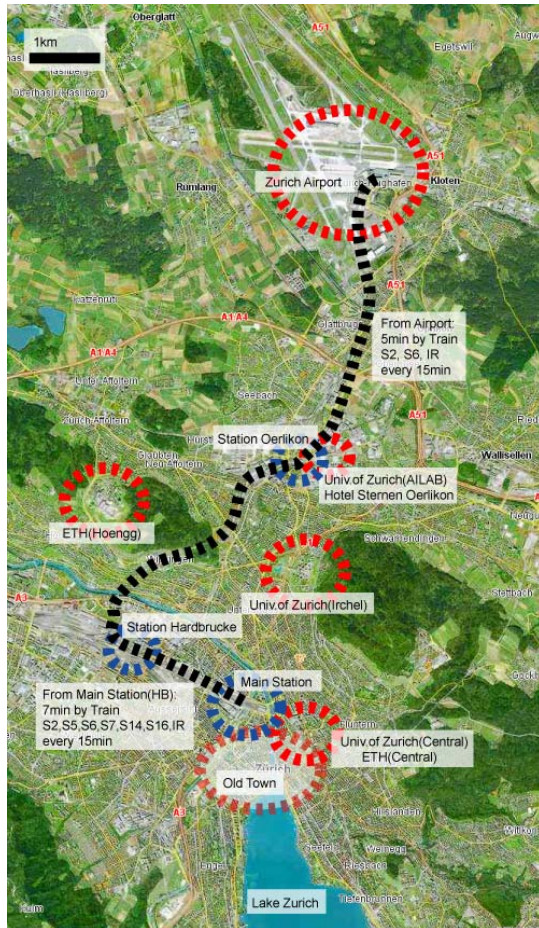
Abstract	**The goal of this project is to develop a simple communication system between plant and robots. The student is requested to understand the sensing techniques of the plant and build robotic devices which can interfere to communicate with the plant.**
Task description **Total: 2-4 months**	1. Acquiring basic background skills and knowledge of robotics: getting familiar with inclination sensors, Arduino programming microchip (1 month) 2. Designing a communication framework and conducting the first experiment with Avocado plant (1 month) 3. Speculating the outcomes and designing second generation model. Carrying out the final experiment and formalize the model. (1 month) (4. Potential extensions: plant to plant communication with the interference of robots) 5. Writing your report
Requirements	Bring your motivation. We will teach basic skills of hardware. The required skill can be varied and the topics are diverse according to his/her specialty.
Skills you can obtain	Knowledge of robotics: sensors, controller board, actuators (servo).

Topic 2: plant prosthetics (cyborg plant)

Abstract	**The goal of this project is to design prosthesis of plant with robotics technology. The aim is building prosthetic devices to support plants under environmental stress and develop theoretic and practical methods to increase the robot-plant adaptability.**
Task description **Total: 2-4 months**	1. Acquiring basic background skills and knowledge: getting familiar with actuators (servo), sensors (1 month) 2. Designing experimental setup and conducting the first experiment (1 month) 3. Observe the changes of the growth of the plant and report. Designing second generation (1 month) 4. Experiments: Carrying out the final experiment and formalize the model and the results. (1 month) 5. Writing your report
Requirements	Bring your motivation. We will teach basic skills of hardware. The required skill can be varied and the topics are diverse according to his/her specialty.
Skills you can obtain	Knowledge of designing robot, actuating techniques (servo), microchips.

7. Contact and the Work environment

The place is in Oerlikon, Zurich, where all the facilities as well as the working space are prepared.

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Looking forward to your contact!!