PotPet: Pet-like Flowerpot Robot

Ayumi Kawakami[1]
kawakami.ayumi@is.ocha.ac.jp

Koji Tsukada[1,2]
tsuka@acm.org

Keisuke Kambara[1]
kambara@sappari.org

Itiro Siio[1]
siio@acm.org

[1] Ochanomizu University,
2-1-1 Otsuka, Bunkyo-ku, Tokyo 112-8610, Japan

[2] PRESTO, Japan Science and Technology Agency, 4-1-8 Honcho Kawaguchi, Saitama 332-0012, Japan.

ABSTRACT
We propose a flowerpot-type robot called PotPet that helps users grow plants more effectively and enjoyably. PotPet acts autonomously like pets: it automatically moves to sunny places or approaches people when it requires water. Basically, PotPet consists of a "real" plant, several sensors to detect plant status, a robot with wheels for mobility, and a microcontroller to control the above devices. Here we explain the concepts and implementation of the PotPet.

Author Keywords
Plants, robot, sensor, pet

ACM Classification Keywords
H5.2 [Information interfaces and presentation]: User Interfaces.

General Terms
Design, Human Factors

INTRODUCTION
Many people grow plants at home, often placing flowerpots in their kitchens or living rooms and planting flowers or trees in their gardens. Thus, plants are a common hobby. However, many people often experience difficulties in keeping their plants healthy. For example, people sometimes kill plants by forgetting to water them. We consider this difficulty to result from the inability of plants to express their needs.

For this reason, we propose a flowerpot-type robot called PotPet that helps users grow plants effectively and enjoyably.

Figure 1. PotPets installed at Ocha House[1]

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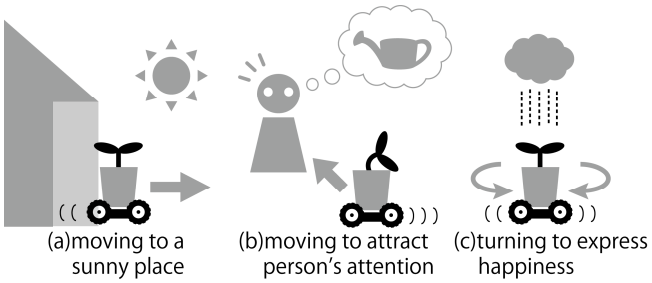

Figure 2. Basic behaviors of PotPet

POTPET
The main concepts underlying the development of the PotPet are as follows:

- Autonomous behavior that imitates that of pets to help grow plants effectively
- Immediate feedback to user actions for entertainment

To achieve the above concepts, we propose two functions: (1) detecting proper plant status and (2) presenting the status *via* physical movement.

Detecting proper plant status
To detect the proper plant status using sensors, we selected three fundamental conditions that significantly affect plant growth: the need for sunlight, water, and people.

First, while plants need an appropriate amount of sunlight, too strong sunlight may damage leaves and flowers. Second, serious problems often arise from under- or over-watering as people cannot accurately judge the plants needs at a glance. Third, we need to detect the presence of the people growing the plants to provide the proper feedback mentioned in the following section.

Presenting the status *via* physical movement
We decide to enable plants to physically move in their flowerpot to imitate the autonomous behavior of pets. Moreover, we propose immediate feedback to the action people in the vicinity *via* movement to make growing plants more enjoyable. Here, we explain basic behavior of the PotPet (Figure 2). First, the PotPet automatically moves to

[1]Ocha House: an experimental smart house for evaluating ubiquitous computing applications in Ochanomizu University.

sunny spots in search of sunlight. Second, the PotPet moves around a person to attract her/his attention when in need of water. Third, the PotPet turns round to express happiness when it is watered, either by a person or by rain.

IMPLEMENTATION

The PotPet basically consists of a driving component, a sensor component, a control component, and a flowerpot component, as shown in Figure 3. Next, we briefly explain each component.

Driving component

We developed the driving component based on the Wifibot[1], a commercial robot with 4 wheels and good mobility. We can control the Wifibot by sending several bytes of commands via the RS232 connection.

Sensor component

We attached four types of sensors in the sensor component: a humidity sensor to detect soil moisture level, a light sensor to detect sunlight, motion sensors to detect the presence of people, and ultrasonic sensors to detect distance to walls or objects.

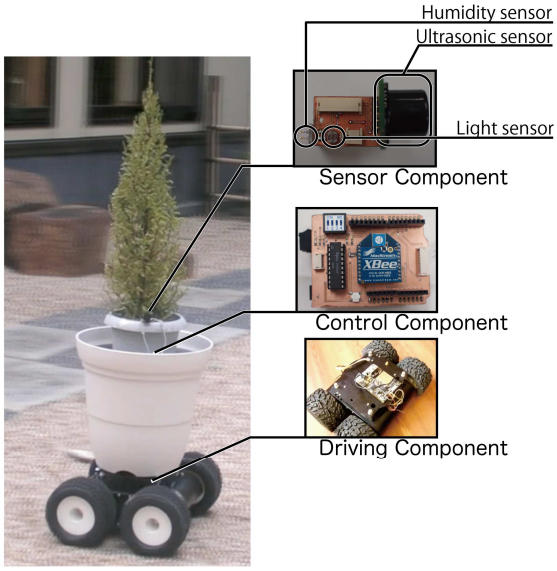

Figure 3. The PotPet prototype.

Control component

We developed the control component based on a microcontroller (Arduino Duemilanove) and a wireless communication device (XBee[2]). The control component collects output from the sensors, and controls the Wifibot based on several rules, as shown in Figure 2. Moreover, this component transmits the sensor data to the backend server at regular intervals for future expandability (Figure 4).

[2] Wifibot: http://www.wifibot.com
[3] XBee: a small wireless module compatible with ZigBee.

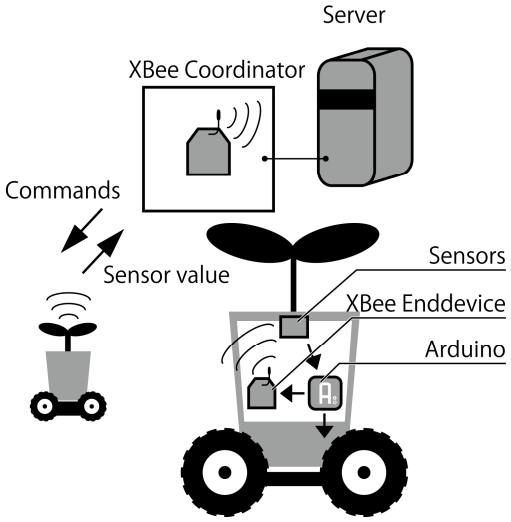

Figure 4. The system architecture of the PotPet.

Flowerpot component

The flowerpot component consists of a "real" plant in a flowerpot. Finally, we assembled the above 4 components: the sensor component, control component and flowerpot component were assembled in a larger flowerpot, which was then set on the driving component.

RELATED WORK

I/O Plants[1] is one trial that uses plants as interactive input/output devices by attaching actuators and sensors. DIGITAL POT[2] is a flowerpot with a display to indicate facial expressions according to the values from sensors attached to the plant. Social Trash Box[3] is a trash robot that moves autonomously in a public space. The robot is not able to collect litter, but encourages people to pick up litter by its interactive movement.

CONCLUSION

We proposed a flowerpot-type robot called PotPet that helps users grow plants effectively and enjoyably. We designed PotPet to act autonomously like a pet: it automatically moves to sunny places or approaches people when it requires water. We plan to extend the behavior of PotPet based on the types, sizes and growth phases of the "real" plants attached to it, and will install PotPet in a garden of an actual house and evaluate its effectiveness (Figure 1).

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