A Self-Feeding Robot

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The Problem: The goal is to build an autonomous robot capable of acquiring its "food" when "nourishment" is needed. In this case, the "food" is the electric energy acquired from power outlets in the walls. The robot uses this energy to recharge its batteries in order to maintain an adequate level of energy for operating.

Motivation: Biological models have been the inspiration for much of the current Embedded Robotics research, as in the work done by Brooks [2]. Perhaps, some of the most important contributions are the emotional models. In these models, complex behaviors are represented in successful ways such as in robots like Kismet [1], and Coco. However, some aspects of living creatures have not been completely explored in these models. One of these aspects is the need that living creatures have for food in order to maintain an adequate energy level to function. In order to satisfy this need, living creatures have certain capabilities for acquiring food. These skills not only satisfy their food requirements, but also contribute greatly to their autonomy and survival.

Consequently, acquiring "food" to maintain an adequate level of energy is an important consideration for the attainment of robotic autonomy.

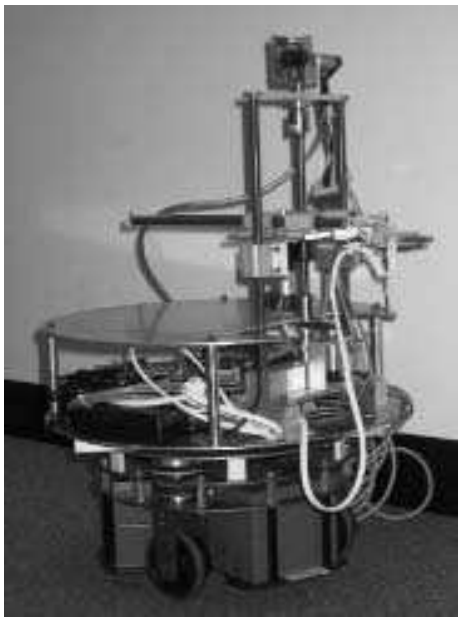

Figure 1: Self-Feeding Robot

Previous Work: The idea of implementing a robot with the capability of "feeding" itself can be tracked down to Walter's robot [5, 6, 7]. It is interesting to note that Walter referred to his robot as an "Imitation of Life" [5]. His robot was considered a rough prototype of a living organism. In 1964 the Hopkins Beasts were built at the Johns Hopkins University Applied Physics Laboratory. These robots were able to navigate the corridors using sonar. When they ran out of power, they looked for outlets to recharge themselves. One of the Hopkins Beast found the power outlets

by feeling along the walls. Another used photocells to optically find the outlets from a distance. The outlets had to contrast with the wall in order to work. Sojourner [3] is another well-known representative of a robot that survives in its environment. However, it does not need to look for its energy sources because its solar panels automatically do the work as soon as the sunlight hits them.

Other autonomous robots that power themselves use different strategies. For example, SAGE [4] uses electrical energy while Gastrobot [8] uses chemical energy. SAGE gives tours in the Carnegie Museum of Natural History. This robot recharges itself when it returns to its base. However, the robot uses very visible artificial markers to identify its base and to recharge its battery. Unlike SAGE, Gastrobot has an artificial stomach that processes sugar to recharge its batteries. However, this robot is not capable of obtaining its own food.

Figure 2: Plug

Approach: In order for the robot to be capable of "feeding" itself, the robot has: a digital color camera, a two degree of freedom arm, a plug with passive remote compliance (figure 2), a wheeled base, motor controllers, and a laptop on board. A picture of the robot is shown in figure 1 . The robot has the following skills: searching for power outlets, connecting to power outlets, and recharging its batteries.

When the robot needs to recharge its batteries, a visual search detects power outlets. Once an outlet is detected, a visual navigation system directs the robot towards the power outlet. The robot then accesses the power outlet using the plug on its arm and visual feedback. When there is electrical contact between the power outlet and the robot, the robot's batteries start to recharge.

Future Work: More behaviors are going to be added to the robot's architecture. The goal is obtaining a robot that can be qualified as a "living" creature by a human observer. Currently, the robot's hardware is being replaced to obtain a more robust robotic architecture.

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