

Photovoltaic Martian Bugs

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Abstract

The goal of this project is to create a solar-powered autonomous robot capable of continuous operation under adequate light conditions. The system is based around a low power 8051 microcontroller. The microcontroller provides the modes of operation that the robot uses to interact with its environment. These modes are influenced by input from several sensors mounted on the robot.

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Introduction

The Photovoltaic Martian Bugs are small, autonomous, mobile, solar-powered robots equipped with two light sensors and three collision sensors. These inputs control the operation of the bugs in the primary operating modes. The output of the system will be motion created by a pair of drive motors. The inputs and outputs are depicted in Figure 1.

Figure 1: System Block Diagram

The bugs have two modes of operation as shown in Figure 2. In the default sleep mode, the bugs wait for the light level detected by the light meter to be sufficient to enter active mode. Once in active mode the bug moves and interacts with its environment according to one or more behavioral settings. The backup battery will charge during this mode if sufficient power is available. If the light meter detects that the light level has become insufficient to maintain active mode, the controller circuitry will be alerted, and the bug will gracefully return to sleep mode.

The bugs have four behaviors during active mode. In the default random walk behavior, the bug moves N units forward, and then turns M degrees, continuously, where N and M are randomly chosen at each step. While the bug is moving it may make contact with obstacles (walls, feet, other bugs, etc.). In such an event the bug will stop, back up a fixed distance and turn 45 degrees away from the object. The bug will determine what direction to turn with a set of antenna-like feelers attached to contact switches. When the bug makes contact with one feeler it will back up and turn away from the object. For example, if the bug were to make contact with the left feeler, it would back up and turn

right. If it made contact with both feelers at the same time it would back up and randomly turn left or right.

The bugs will remain in random walk mode until the light level drops below satisfactory levels. If the light level becomes too low to maintain continuous operation, the bug will enter into the forage behavior and begin moving towards the area with more light. It will continue foraging until the light level returns to a predefined acceptable range or a sufficient energy source is located.

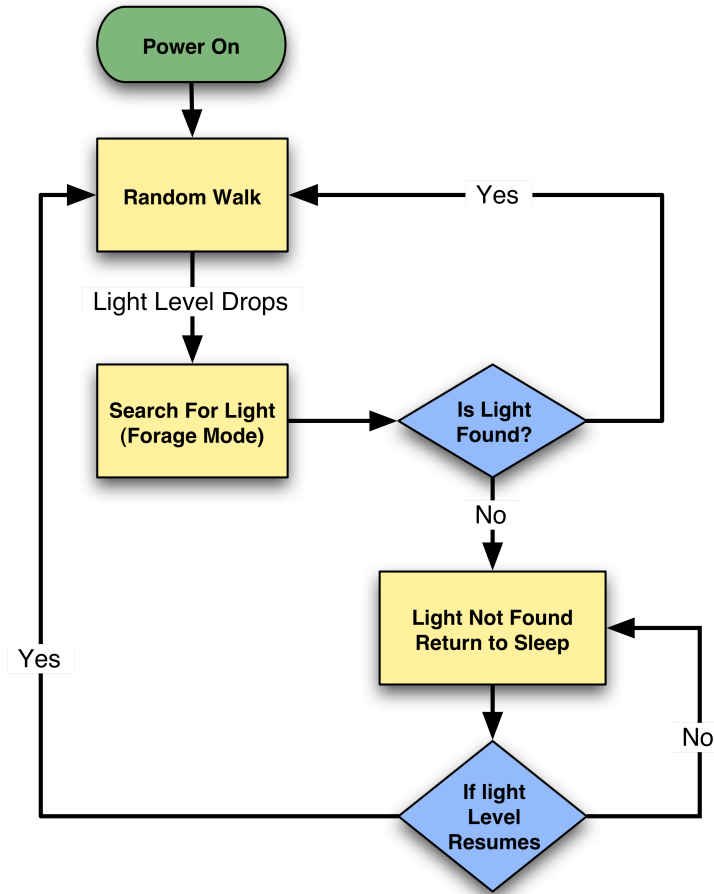


Figure 2: Software Flow