CSCI 1106
Lecture 12

Introduction to Robotics

Announcements

• Today's Topics
  – Overview of Robotics Module
  – What is Robotics?
  – Anatomy of a Robot
  – The Sense- Decide- Act Cycle
  – Introduction to the Aseba Studio
The Robotics Module

Topics
• Overview of Robotics
• Hardware
  – Sensors
  – Actuators
• Software
  – State Transition Diagrams
  – Event Based Architecture
  – Dealing with Failure
  – Planning
  – Debugging
  – Programming Techniques

To Do List
• Six tutorials:
  – Introducing the Thymio II
  – Modeling sensors
  – Modeling actuators
  – Modeling the real world
  – Recovering from faults
  – Programming Techniques
• Robot Olympics Project
  – Design three programs to compete in the Robot Olympics
  – Implement the programs
  – Compete in the Robot Olympics
  – Write a technical report

What is Robotics?
• From the Thrun, Burgard, and Fox
  “Robotics is the science of perceiving and manipulating the physical world through computer-controlled devices.”
Anatomy of a Robot

• Components:
  – Sensors
  – Controller
  – Actuators
The Sense-Decide-Act Framework
Programming in Aseba

- Programs are text-based
- Key Ideas:
  - Everything is done by event handlers
  - A robot is a sprite
  - The world is the stage
- Observation this is similar to game design!

Scratch vs Aseba

**Scratch**
- Variables
- Event Handler
- Conditional

**Aseba**
- Variables
- Event Handler
- Conditional
Scratch vs Aseba

**Scratch**
- Variable/List Assignment
- Expressions
- Motion

**Aseba**
- Variable/List Assignment
- Expressions
- Motion

The Four Parts of an Aseba Program

- Variable declarations
  - Begin with the `var` keyword
- Initialization code
  - Anything except declarations
- Subroutines
  - Begin with the `sub` keyword
- Event handlers
  - Begin with the `onevent` keyword
A Sample Program

```plaintext
var speed = 100
motor.left.target = 0
motor.right.target = 0

onevent button.forward
  motor.left.target = speed
  motor.right.target = speed

onevent button.backward
  motor.left.target = 0
  motor.right.target = 0

onevent button.left
  motor.left.target = -speed
  motor.right.target = speed

onevent button.right
  motor.left.target = speed
  motor.right.target = -speed
```

Key Idea: Actuators are controlled by setting variables that represent them.

Sensors and Actuators in Aseba

- **Key Idea:** All sensors and actuators are accessed via predefined variables, e.g.,
  - to control motors, assign values to motor variables
    ```plaintext
    motor.left.target = 100
    motor.right.target = 100
    ```
  - to check if an object is close, read proximity variable
    ```plaintext
    if prox.horizontal[2] > 1000 then...
    end
    ```
- Where are all the predefined variables listed?
- When do we check variables?
Aseba Studio


When do We Check the Sensors?

- Key Idea: Sensors generate events. Event handlers check sensors. E.g.,
  - Proximity (prox) sensors generate 10 events per second
    
    ```
    onevent prox
    if prox.horizontal[2] > 1000 then
        motor.left.target = 0
        motor.right.target = 0
    else
        motor.left.target = 100
        motor.right.target = 100
    end
    ```

- Scratch and Aseba are very similar!
Event Driven Framework
(Wait) Sense (Event)-Decide-Act

Last Example

onevent prox
  if prox.horizontal[2] > 1000 then
    motor.left.target = 0
    motor.right.target = 0
  elseif prox.horizontal[4] > 1000 then
    motor.left.target = -100
    motor.right.target = 100
  elseif prox.horizontal[0] > 1000 then
    motor.left.target = 100
    motor.right.target = -100
  else
    motor.left.target = 100
    motor.right.target = 100
  end