Machine Intelligence Laboratory

Potpourri

- Software Design Review - In designing IMDL robots you will develop three types of software, mainly, low-level, sensor and motor routines
  - All behaviors are (should be) independent and can be both developed and debugged separately
  - We want to be able to add, remove or change behaviors at will without having to substantially rewrite software
  - We want to integrate behavior interaction easily
- Low-Level Routines
  - Perform housekeeping functions within the robot
  - Do not perform logic or decision-making
  - DO perform basic tasks in support of higher-level processes (e.g., read a digital compass and return orientation value)

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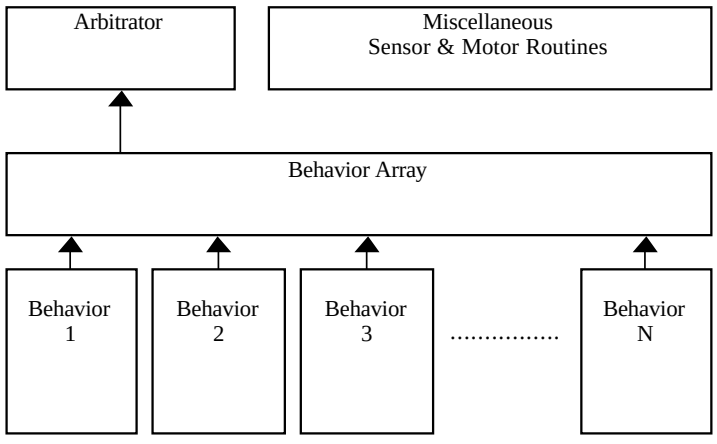

Figure 1: Behavior Program Architecture

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- Sensor Routines
  - Sensor control (e.g., controlling the frequency on an IR cannon mounted on a servo)
  - Collect data and fill global variable slots for essential external communication
  - Error correction
  - Default values
  - Filtering

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- Collecting Sensor Data
  - Make an array, say DEBUG[20] and use it to record 20 readings of a global sensor value, etc. Now you can print all 20 values with a single *printf* statement.
  - Smooth the sensor data

    If you have, say, 20 values stored in S[20] then let

    $$S_{now} = (1/20) \sum_{1}^{20} S[i]$$

  - Filter and/or correct the sensor data

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- Motor Routines
  - Independent of behaviors (No behavior ever controls the motors directly). Behaviors send motor values to the motor routine via global variables
  - Facilitate smooth motor control
    - Non-smooth behavior may be caused by two or more behaviors competing for control
    - You may wish to implement a "smoothing" function on the motors for more natural "non-jerky" behavior. Jerky behaviors are not physical or biological and cause mechanical difficulties.
    - Switching motor direction or large speed changes can cause "spikes," high currents and place high demand on battery packs

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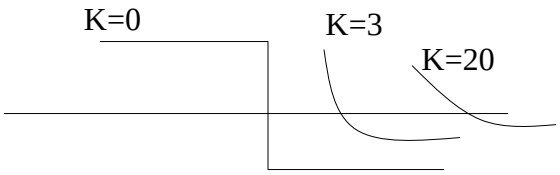
- Speed Control

  Speed = (K/K+1)*Old_value + (1/K+1)*New_value (K≥0)

  Speed = (K-1/K)*Old_value + (1/K)*New_value (K ≥1)



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Programming Behaviors

- Behavior Control
  - *All* behaviors run concurrently
  - The higher priority behavior should subsume the lower priority behavior
  - Each behavior is programmed in its own module
  - A function is written to perform behavior arbitration
  - Behaviors use the sensory global array of values to produce a desired set of global motor values

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Programming Behaviors

- Behavior Arbitration
  - Determine the dominant behavior and set the motor values to the appropriate level
  - May turn off unwanted or turn on additional behaviors
  - May modify the behaviors via global control variables
  - May adjust behavior priority
- Keep your behaviors relocatable
- Make sure you write code to test sub-systems of your robot as you develop them and keep those routines handy during the entire design process

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