Robotic Agents (CMPSC 311)

Lego EV3 Robots

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The see-think-act cycle

1. **Perception**
   - Sensing
   - Information Extraction
   - Localization and Map Building
     - Environment model
     - Local map
   - Knowledge, data base

2. **Cognition**
   - Path Planning
     - "Position" global map
     - Mission commands
   - Cognition
     - Path Execution
     - Acting
     - Actuator commands
     - Path

3. **Motion Control**
   - Real World Environment
   - See-think-act cycle
We will start with simple sensing and acting cycle

![Diagram showing the see-think-act cycle with modules for localization, map building, cognition, path planning, perception, motion control, and real world environment.]
Mobile Robots

- Robot = sensors + actuators.
- Actuators make the mobility possible.
- Sensors are the key components for perceiving the environment.
Lego EV3 Robots

Lego EV3 robot contains a programmable EV3 controller (brick), user interface with an LCD screen, Lego building blocks, motors and various sensors such as light, ultrasonic, color, touch, gyro.
Lego EV3 Robots

The brick contains:
- 4 outputs (motors),
- 4 inputs (sensors),
- USB,
- Bluetooth/Wi-Fi connection,
- LCD screen,
- 16 MB flash memory,
- 64 MB RAM,
- SD Card Port,
- EV3 Brick Button lights,
- sound.
LeJOS is a small Java Virtual Machine, which allows us to write Java programs for Lego robots. LeJOS API documentation: [http://www.lejos.org/ev3/docs/](http://www.lejos.org/ev3/docs/)
1. `EV3UltrasonicSensor sonicSensor = new EV3UltrasonicSensor(SensorPort.S2);`
2. `SampleProvider sonicSamplePr = sonicSensor.getDistanceMode();`
3. `float[] colorSample = new float[colorSamplePr.sampleSize()];`
4. `sonicSamplePr.fetchSample(sonicSample, 0);`
Sensors: Example

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EV3 Gyroscopes

- Preserve their orientation in relation to a fixed reference frame
- They provide an absolute measure for the heading of a mobile system
- Measure rotational motion and changes in its orientation;
- ± 3 degrees accuracy;
- Maximum output of 440 degrees/second;
- Sample rate of 1 kHz;
An ultrasonic sensor works with waves and often it is used in applications for measure distance between a robot and surrounded objects.

The sensor emits sound waves and receives their echoes to detect and measure the distance from one or more objects.

Distance measure up to 250 cm (100-inch);

+/- 1 cm (+/- 0.394-inch) accuracy;

Recognize other ultrasonic sound
EV3 Touch Sensor

- Useful for detection with high accuracy.
- The EV3 Touch Sensor is an analog and simple tool with a button located in the front and a counter for press/release actions of the button.
- Usually used for start/stop control systems, games like maze-solving robots, and many other applications.
EV3 Color Sensor

- Detection for up to seven colors;
- Detect the absence of color;
- It works in ambient light;
- Sample rate of 1 kHz;
- Auto-ID is built into the EV3 Software;
In lab 01 you will learn how to use and program Lego EV3 robots and their sensors.
You will develop Java programs that allow EV3 robots to compete in various robotic field day activities, including:

1. **Sprint race**: all of the robots will start together at the same line and will race along a straight path until a wall is reached. The wall can be detected by the touch sensor or an ultrasonic sensor. The robot that reaches the wall first wins.
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2. **Push race**: all of the robots will start at the same line with a colored box right in front of it. The robot needs to push the box along a path until it pushes the box into a larger box. The robot that pushes the small box into the larger box first wins.
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3. **Obstacle race**: each robot will travel from their starting position straight until they reach the (long) colored finish line, while avoiding (not hitting) obstacles set up in the environment. Penalties will applied if the obstacles are touched, moved or knocked down. The robot that is able to complete the obstacle course by reaching the red finish line the fastest wins.
Sensors and Actuators Used in the Sample Programs

**Sprint Race:**
- Two motors to regulate two wheels;
- Touch sensor to detect the wall.

**Push Race:**
- Two motors to regulate two wheels.

**Obstacle Race:**
- Two motors to regulate two wheels;
- Color sensor to detect the finish line;
- Ultrasonic sensor to facilitate obstacle avoidance.
Needed Installation

- The Lego EV3 robots have already been pre-configured with LeJOS by the instructor and the system administrator.
- Eclipse plugin will be used to connect to the EV3 robot as it provides a Lego EV3 plugin for an easy development and running of leJOS programs on EV3.
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Today’s Tasks:

1. Install Eclipse and LeJOS EV3 plugin: https://sourceforge.net/p/lejos/wiki/Installing%20the%20Eclipse%20Plugin/
2. Continue building your team’s EV3 robot with the design appropriate for the lab01’s races.