MaSH Environment rcx2threads

Andrew Rock
School of Information and Communication Technology
Griffith University
Nathan, Queensland, 4111, Australia
a.rock@griffith.edu.au

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1 Purpose

This environment supports programming a Lego Mindstorms RCX robot, via the Lejos system, for programs that require two execution threads.

2 Rewrites

*mandatory*

```java
void main ()
```

*Purpose*: A program that is organised into methods must have a `main` method (a procedure with no arguments). This will be the first method to execute. `mashc` automatically rewrites this method to conform to standard Java.

3 Setting up sensors

3.1 Constants

```java
final int TOUCH
```

*Purpose*: Constant to select sensor type touch.
final int LIGHT

    Purpose: Constant to select sensor type light.

final int ROTATION

    Purpose: Constant to select sensor type rotation.

3.2 Methods
void setUpSensor (int port, int type)

    Purpose: Sets up the port to be sensor of the given type.

    Precondition: port is 1, 2, or 3.

    Precondition: type is TOUCH, LIGHT, or ROTATION.

4 Using touch sensors
4.1 Methods
void waitForPush (int port)

    Purpose: Makes the program wait until the touch sensor on port is pushed.

    Precondition: port is 1, 2, or 3.

    Precondition: The port has been set up as a touch sensor.

void waitForLetGo (int port)

    Purpose: Makes the program wait until the touch sensor on port is let go.

    Precondition: port is 1, 2, or 3.

    Precondition: The port has been set up as a touch sensor.

boolean isPushed (int port)

    Purpose: Returns true if and only if the button on port is currently pushed.

    Precondition: port is 1, 2, or 3.

    Precondition: The port has been set up as a touch sensor.
5 Using light sensors

5.1 Methods

void waitForLighter (int port, int dif)

*Purpose:* Makes the program wait until the light sensor reading on *port* is increased by *dif*.

*Precondition:* *port* is 1, 2, or 3.

*Precondition:* The port has been set up as a light sensor.

*Precondition:* *dif* is between 0 and 100, inclusive. 0 is no wait at all. Real light levels never really change by anything like 100.

void waitForLight (int port, int light)

*Purpose:* Makes the program wait until the light sensor reading on *port* is at least the desired *light* level.

*Precondition:* *port* is 1, 2, or 3.

*Precondition:* The port has been set up as a light sensor.

*Precondition:* *light* is between 0 and 100, inclusive.

void waitForDarker (int port, int dif)

*Purpose:* Makes the program wait until the light sensor reading on *port* is decreased by *dif*.

*Precondition:* *port* is 1, 2, or 3.

*Precondition:* The port has been set up as a light sensor.

*Precondition:* *dif* is between 0 and 100, inclusive. 0 is no wait at all. Real light levels never really change by anything like 100.

void waitForDark (int port, int light)

*Purpose:* Makes the program wait until the light sensor reading on *port* is at most the desired *light* level.

*Precondition:* *port* is 1, 2, or 3.

*Precondition:* The port has been set up as a light sensor.

*Precondition:* *light* is between 0 and 100, inclusive.

int getLight (int port)

*Purpose:* Returns the current light sensor reading on *port*.

*Precondition:* *port* is 1, 2, or 3.

*Precondition:* The port has been set up as a light sensor.
6 Using rotation sensors

6.1 Methods

void waitForRotation (int port, int rotation)

*Purpose:* Makes the program wait until the counter in the rotation sensor on *port* has changed by at least the absolute value of *rotation*.

*Precondition:* *port* is 1, 2, or 3.

*Precondition:* The port has been set up as a rotation sensor.

int getRotation (int port)

*Purpose:* Returns the current rotation sensor reading on *port*.

*Precondition:* *port* is 1, 2, or 3.

*Precondition:* The port has been set up as a rotation sensor.

void resetRotation (int port)

*Purpose:* Sets the counter in the rotation sensor on *port* to zero.

*Precondition:* *port* is 1, 2, or 3.

*Precondition:* The port has been set up as a rotation sensor.

7 Output port constants

7.1 Constants

final int A

*Purpose:* Constant to select port A.

final int B

*Purpose:* Constant to select port B.

final int C

*Purpose:* Constant to select port C.
8 Using motors

8.1 Methods

void motorForward (int port, int power)

    Purpose: Make the motor on port go forwards at the given power.

    Precondition: port is A, B, or C.

    Precondition: power is between 0 and 7, inclusive.

void motorBackward (int port, int power)

    Purpose: Make the motor on port go backwards at the given power.

    Precondition: port is A, B, or C.

    Precondition: power is between 0 and 7, inclusive.

void motorStop (int port)

    Purpose: Stop the motor on port.

    Precondition: port is A, B, or C.

void motorFloat (int port)

    Purpose: Float the motor on port.

    Precondition: port is A, B, or C.

9 Using lamps

9.1 Methods

void lampOn (int port, int power)

    Purpose: Make the lamp on port go on at the given power.

    Precondition: port is A, B, or C.

    Precondition: power is between 0 and 7, inclusive.

void lampOff (int port)

    Purpose: Turns the lamp on port off.

    Precondition: port is A, B, or C.
10 Waiting for fixed times

10.1 Methods

void sleep (int ms)

Purpose: Makes the program wait for a requested number of ms (milliseconds).

11 Making sounds

11.1 Methods

void systemSound (int i)

Purpose: Play system sound number i. The system sounds are as follows.

<table>
<thead>
<tr>
<th>i</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>short beep</td>
</tr>
<tr>
<td>1</td>
<td>double beep</td>
</tr>
<tr>
<td>2</td>
<td>descending arpeggio</td>
</tr>
<tr>
<td>3</td>
<td>ascending arpeggio</td>
</tr>
<tr>
<td>4</td>
<td>long, low beep</td>
</tr>
<tr>
<td>5</td>
<td>quick ascending arpeggio</td>
</tr>
</tbody>
</table>

Precondition: \(0 \leq i \leq 5\).

void playTone (int frequency, int duration)

Purpose: Plays a tone, given its frequency (Hertz) and duration (centiseconds).

Precondition: \(31 \leq \text{frequency} \leq 2100\).

Precondition: \(0 \leq \text{duration} \leq 256\).

12 Using the LCD

12.1 Methods

void showNumber (int a)

Purpose: Displays a number in the LCD. Does not require refresh().

Precondition: \(0 \leq a \leq 9999\).

void clear ()
Purpose: Clears the LCD, but the effect will not show until `refresh()` is called.

```java
void refresh()
```

Purpose: Refreshes the LCD, causing the changes to be displayed.

```java
void putChar(char c, int i)
```

Purpose: Puts a character `c` into the LCD at position `i`.

Precondition: $0 \leq i \leq 4$.

### 13 Using infra-red communications

#### 13.1 Methods

```java
void sendByte(int i)
```

Purpose: Send one byte of information to another RCX, by infra-red transmission. The value to send, `i`, will be truncated if it can’t fit in a byte.

```java
int receiveByte()
```

Purpose: Waits for and returns a new byte sent by another RCX via infra-red transmission.

### 14 Math

#### 14.1 Purpose

The following are some commonly used numeric constants and functions.

#### 14.2 Constants

```java
final int MAX_INT
```

Purpose: A constant holding the maximum value an `int` can have, $2^{31} - 1$.

```java
final int MIN_INT
```

Purpose: A constant holding the minimum value an `int` can have, $-2^{31}$.

```java
final double PI
```

Purpose: The closest `double` approximation to $\pi$.

```java
final double E
```

Purpose: The closest `double` approximation to $e$. 8
14.3 Methods

double abs (double a)

*Purpose:* Returns the absolute value of a.

int abs (int a)

*Purpose:* Returns the absolute value of a.

double ceil (double a)

*Purpose:* Returns the least double value that is greater than or equal to a and equal to an integer.

double exp (double x)

*Purpose:* Returns $e^x$, that is Euler’s constant $e$ raised to power $x$.

double floor (double a)

*Purpose:* Returns the greatest double value that is less than or equal to a and equal to an integer.

double log (double x)

*Purpose:* Returns the natural logarithm of $x$.

double rint (double x)

*Purpose:* Returns the closest mathematical integer to $x$.

int round (float a)

*Purpose:* Returns the closest int to a.

double sqrt (double a)

*Purpose:* Returns the square root of a.

*Precondition:* $a \geq 0.0$.

double pow (double a, double b)

*Purpose:* Returns $a$ raised to the power $b$, $a^b$.

double sin (double a)

*Purpose:* Returns the trigonometric sine of $a$ radians.

double cos (double a)
Purpose: Returns the trigonometric cosine of \( a \) radians.

\[
\text{double tan (double a)}
\]

Purpose: Returns the trigonometric tangent of \( a \) radians.

\[
\text{double asin (double a)}
\]

Purpose: Returns the trigonometric arc sine of \( a \) in radians.

\[
\text{double acos (double a)}
\]

Purpose: Returns the trigonometric arc cosine of \( a \) in radians.

\[
\text{double atan (double a)}
\]

Purpose: Returns the trigonometric arc tangent of \( a \) in radians.

\[
\text{double atan2 (double y, double x)}
\]

Purpose: Returns the angle \( \theta \) from the conversion of rectangular coordinates \((x, y)\) to polar coordinates \((r, \theta)\).

\[
\text{double max (double a, double b)}
\]

Purpose: Returns the greater of \( a \) and \( b \).

\[
\text{int max (int a, int b)}
\]

Purpose: Returns the greater of \( a \) and \( b \).

\[
\text{double min (double a, double b)}
\]

Purpose: Returns the lesser of \( a \) and \( b \).

\[
\text{int min (int a, int b)}
\]

Purpose: Returns the lesser of \( a \) and \( b \).

\[
\text{double random ()}
\]

Purpose: Returns a random value \( x \) such that \( 0.0 \leq x < 1.0 \).

15 Strings

15.1 Purpose

The following are methods for working with Strings.
15.2 Methods

int length (String s)

*Purpose:* Returns the length of s.

char charAt (String s, int i)

*Purpose:* Returns the character at position i in s.

*Precondition:* \(0 \leq i < \text{length}(s)\).

boolean equals (String a, String b)

*Purpose:* Returns true if and only if a contains the same sequence of characters as in b.

boolean parseBoolean (String s)

*Purpose:* Returns s converted to a boolean.

int parseInt (String s)

*Purpose:* Returns s converted to an int.

long parseLong (String s)

*Purpose:* Returns s converted to a long.

float parseFloat (String s)

*Purpose:* Returns s converted to a float.

double parseDouble (String s)

*Purpose:* Returns s converted to a double.

16 Threads

16.1 Rewrites

void run ()

*Purpose:* A program may have a second thread of execution. The run() method contains the statements that perform the actions of the second thread.

16.2 Methods

void start ()

*Purpose:* Start the extra thread and call run().
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