Robots that don’t suck

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iRobot, Asus EEE and RoboRealm

- Developed for an educational visit by Singapore A-level students held 20th July 2008 to 9th August 2008
- Twenty good Physics students, half way through their first A-level year
Daily routine

0815  Breakfast in Glen Eyre Hall
0900  Morning meeting: Progress updates, background for the day.
1000  Hands-on engineering in the laboratory
1300  Lunch
1400  Laboratory continues
1530  Teacher led A-level lessons.
1630  Library and computer access, ad hoc soccer and basketball.
1900  Evening meal
Week 3

Mon 4th    Renewable energy: Photovoltaic experiment and fabrication.

Tue 5th    Robot lab: Introduction to Roomba and NXT.

            (Klaus-Peter Zauner’s microbot swarm)

Thu 7th    System-on-chip with PLDs.

Fri 8th    Wrap up, final reports.

Sat 9th    Depart Heathrow 1830.
iRobot Create

• We went to a lot of trouble to get the iRobot Create; they won’t ship it to the UK.

• It turned out that we didn’t need the special DB25 connector in the Create, nor the special green Create control module.

• We do all our interfacing via the mini DIN connector which is supplied on all 400 and 500 series Roomba machines. On the 500 series, you have to lever the top faceplate off to find it; on the older ones, the connector is under a little slide-off cover on the top edge of the machine.
RoboRealm

- Builds an image processing pipe.
- Allows you to write a control algorithm in VBScript.
- Will directly drive the iRobot.
- We use version 2.0.8.8
We used the iRrobot Create, Asus EEE PC and RoboRealm for quick robot prototyping.
Raw Image with ball
RGB Filter
CG and size
Each RoboRealm module has a GUI; in many cases these give a real-time analysis of the images being processed.
These settings on the blob size filter ensure we only track one object.
In our version of RoboRealm, the iRobot Create module seriously slows the video pipe.

We keep the iRobot motors running very slowly:

\[
ml, \ mr = 30
\]

to help it keep up.
In older versions of RoboRealm, this box was too big to fit on an 800x600 display.
The RoboRealm program is just XML

```xml
<head><version>2.0.8.8</version></head>
<RGB_Filter>
  <channel>2</channel>
  <max_value>100</max_value>
  <hysteresis>30</hysteresis>
  <result_type>2</result_type>
  <min_value>175</min_value>
</RGB_Filter>
<Blob_Size>
  <limit>1</limit>
  <min_area>30</min_area>
  <mask>FALSE</mask>
  <threshold>5</threshold>
  <max_area>1000</max_area>
</Blob_Size>
<Center_of_Gravity>
  <show_coord>TRUE</show_coord>
  <color_index>2</color_index>
  <connect_line>FALSE</connect_line>
  <size_index>5</size_index>
  <density>-1</density>
  <use_subpixel>FALSE</use_subpixel>
  <show_box>TRUE</show_box>
  <box_size>9</box_size>
  <overlay_image>Source</overlay_image>
  <show_cog>TRUE</show_cog>
  <threshold>-1</threshold>
</Center_of_Gravity>
<VBScript_Program>
  <script>x=GetVariable("COG_X")
   s=GetVariable("COG_AREA")
   ml=30
   mr=30
   if s &gt;= 400 then
     ml=0
     mr=0
   elseif x &lt;= 50 then
     ml=0
   elseif x &gt;= 110 then
     mr=0
   end if
   SetVariable "ML", ml+128
   SetVariable "MR", mr+128
   </script>
</VBScript_Program>
<IRobot_Create>
  <right_motor_max>255</right_motor_max>
  <pwm_1_value>128</pwm_1_value>
  <left_motor_value>128</left_motor_value>
  <pwm_2_value>128</pwm_2_value>
  <right_motor_value>128</right_motor_value>
  <pwm_1_max>128</pwm_1_max>
  <pwm_2_max>128</pwm_2_max>
  <start_oimode>2</start_oimode>
  <left_motor_min>128</left_motor_min>
  <left_motor_max>255</left_motor_max>
  <left_motor_map>ML</left_motor_map>
  <pwm_3_value>128</pwm_3_value>
  <digital_out_1_value>FALSE</digital_out_1_value>
  <digital_out_2_value>FALSE</digital_out_2_value>
  <com_port>COM7 - USB Serial Port</com_port>
  <pwm_3_max>128</pwm_3_max>
  <right_motor_map>MR</right_motor_map>
  <right_motor_min>128</right_motor_min>
  <right_motor_max>255</right_motor_max>
  <digital_out_3_value>FALSE</digital_out_3_value>
  <pwm_2_max>128</pwm_2_max>
</IRobot_Create>
```
• RoboRealm web site: http://www.roborealm.com

• RoboRealm Help http://www.roborealm.com/help/

Setting up the EEE Screen

• For older versions of RoboRealm, you need to run the screen in at least 1280x960 mode, so as to see all of the iRobot Create Controller window.

1. Download AsTray+1.3.7.zip and put the extracted files AsTray.exe and DrvPatch.dll in the same folder.
2. Execute AsTray.exe. If it works you’ll see a tray icon in the windows tray pad.
3. Disable the Intel driver services igfxpers.exe and igfxtray.exe using start menu → run → msconfig → start up.
4. Reboot the EeePC to make the tweaks take effect.
5. To make AsTray Plus run during windows start-up, copy AsTray.exe and DrvPatch.dll into the c:\program files\asus\eeepc ACPI\ folder of Asus's original AsTray, replacing the original version.

• There is information on VBScript programming at http://msdn.microsoft.com/en-us/library/0ad0dkea(VS.80).aspx
You can use VBScript through Extensions→VBScript_Program

• You can control the iRobot Create through Control→Robots→Irobot_Create
Hardware hacking the iRobot

- We do not use the Cargo Bay DB25 connector at all.

- We modify the supplied serial port (mini DIN) lead to provide a USB connection. We could use a separate USB/RS232 converter, but our solution is cheaper, neater, and consumes less power from the EEE battery.

- We modify the battery box to bring out power leads which we route round the iRobot to the cargo bay. Here we use a series pair of 8.4V NiMH rechargeable battery packs. Please be careful. The iRobot seems very sensitive to overvoltage; we have burnt out motor drivers, complete with a puff of smoke!
A simple sheet aluminium mount for the EEE
Modified Battery Case

Just connect to the internal terminals. This is much easier than opening up the robot.
USB lead
Hardware parts

- USB to low voltage serial converter—parts from Farnell ([oncall](#))
  - 1329311: FTDI - TTL-232R-3V3 - CABLE, USB TO TTL LEVEL, SERI
  - CN09987 : HARWIN - M20-9990646 - 0.1" PIN HEADER - 6 WAY

- NiMH batteries—parts from [ModelPower](#)
  - Two series connected 8.4 Volt 3300mAh NiMh Sub C Power Pack
  - Tamiya Large Connector - Plug & Socket (2 off)
### Connections for the USB port

<table>
<thead>
<tr>
<th>Mini DIN</th>
<th>#4814 cable</th>
<th>USB adaptor</th>
</tr>
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<td>n/c</td>
</tr>
<tr>
<td></td>
<td>black</td>
<td>n/c</td>
</tr>
</tbody>
</table>

Top view of female DIN connector in iRobot
Setting up the USB Serial port

- Download and unpack the driver [CDM 2.04.06 WHQL Certified.zip](#).

- Plug in the USB connector and point the *New Hardware* wizard (twice) at the unpacked driver.