UNIVERSITY OF Southampton
School of Electronics and Computer Science

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

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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

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Week 3

Mon 4th	Renewable energy: Photovoltaic experiment and fabrication.
Tue 5th	Robot lab: Introduction to Roomba and NXT.
Wed 6th	Robot lab: Autonomous robot agents. (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

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- 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.

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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

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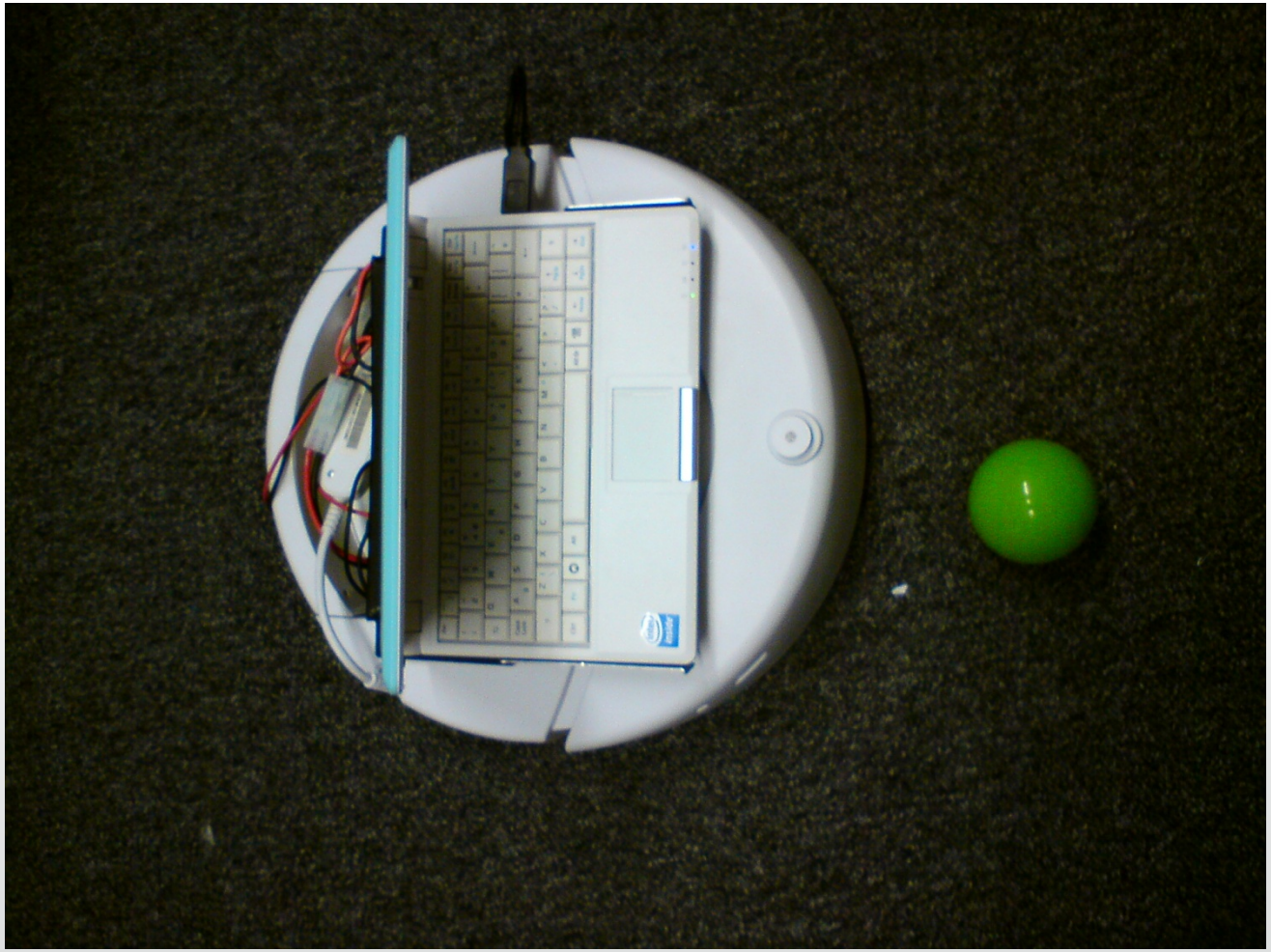

We used the iRrobot Create, Asus EEE PC and RoboRealm for quick robot prototyping.

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Raw Image with ball

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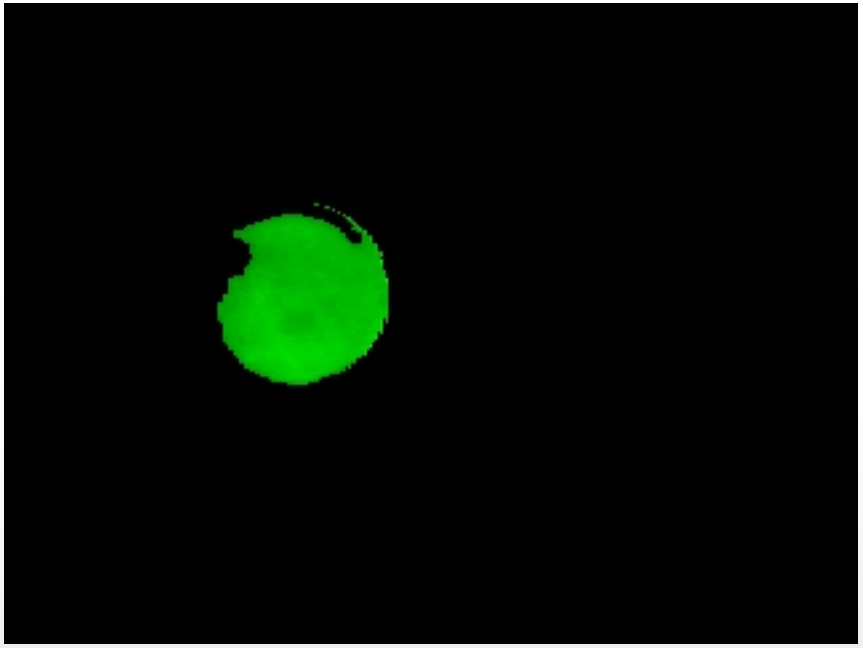
RGB Filter



CG and size

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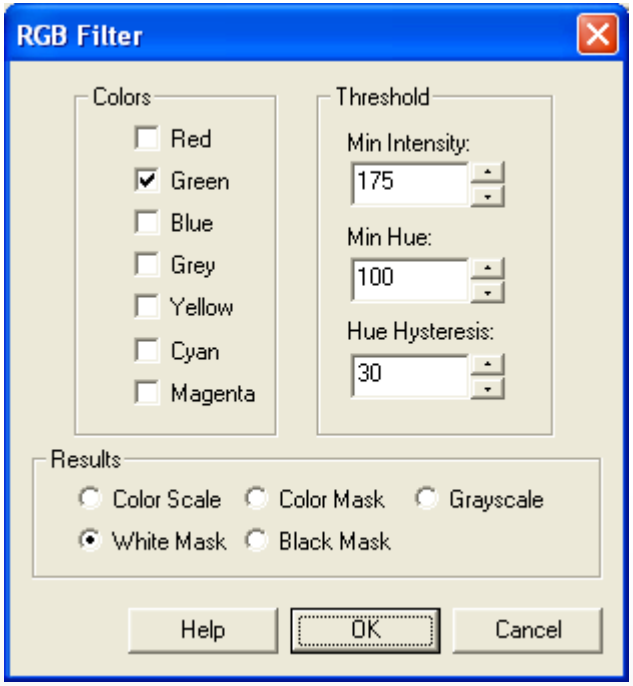

Each RoboRealm module has a GUI; in many cases these give a real-time analysis of the images being processed.

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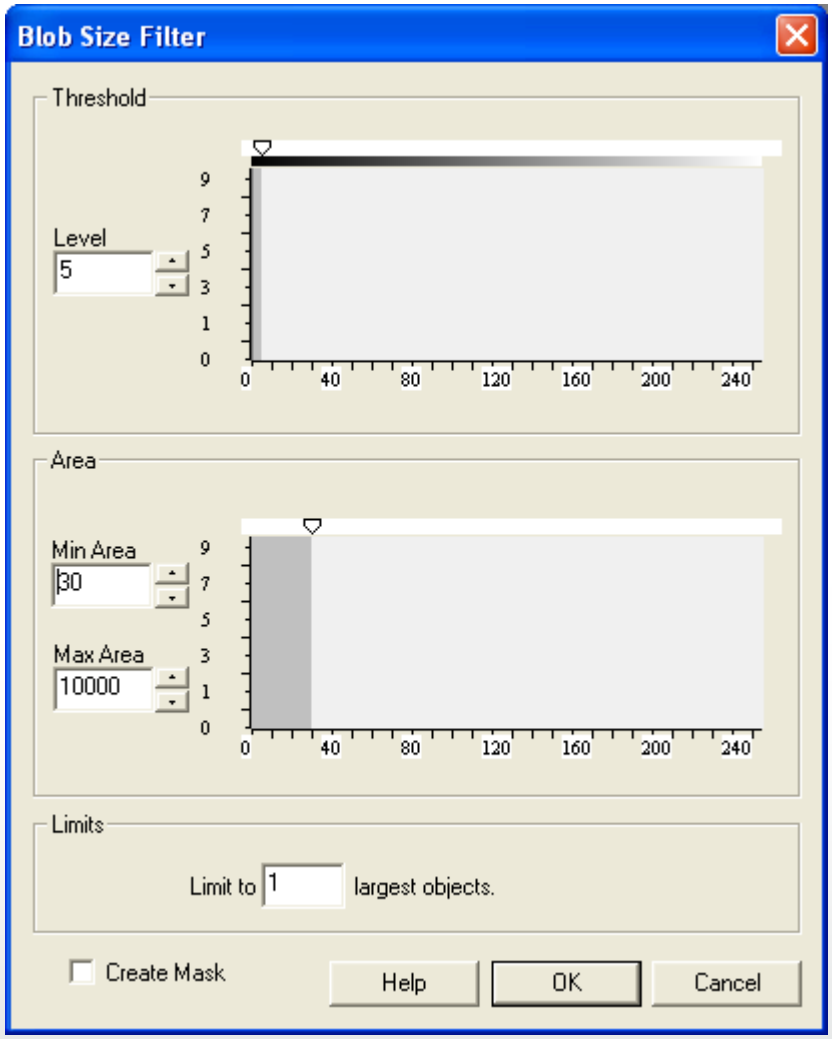

These settings on the blob size filter ensure we only track one object.

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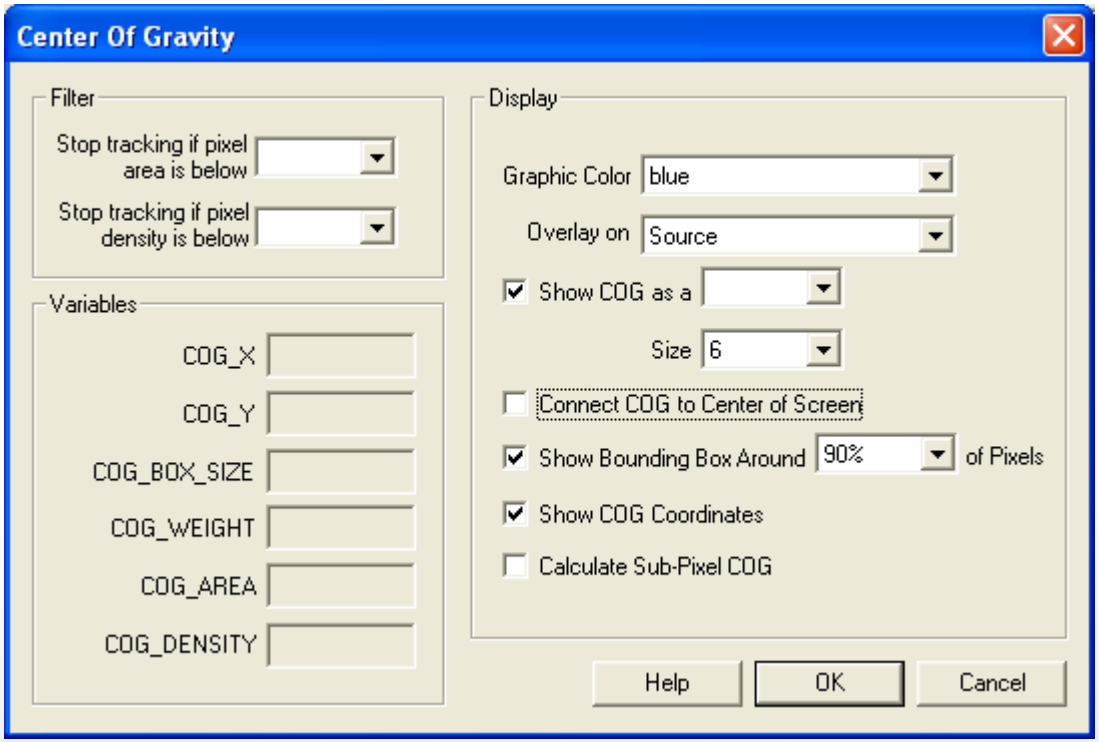

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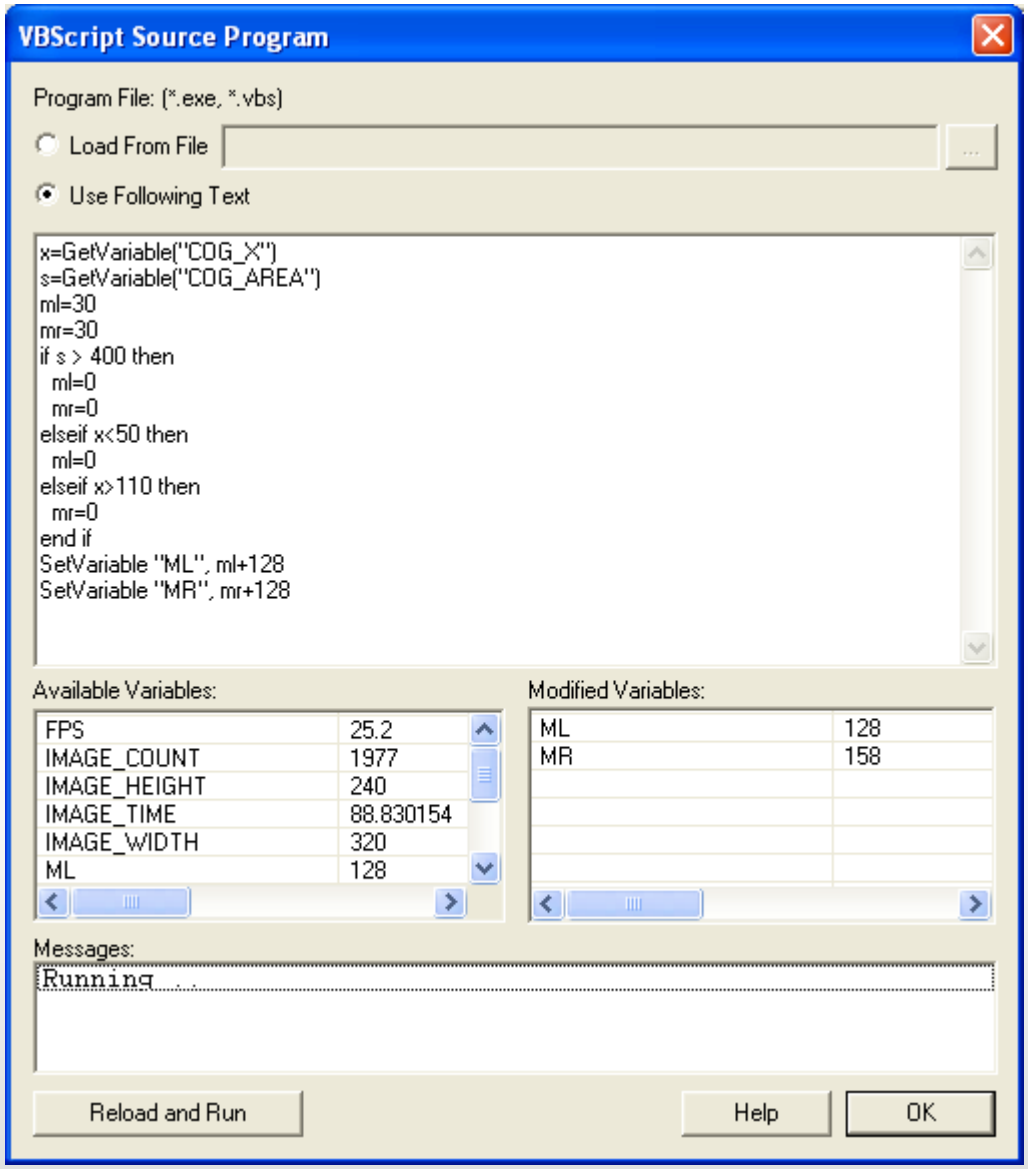

In our version of RoboRealm, the iRobot Create module seriously slows the video pipe.

We keep the iRobot motors running very slowly:

```
ml, mr = 30
```

to help it keep up.

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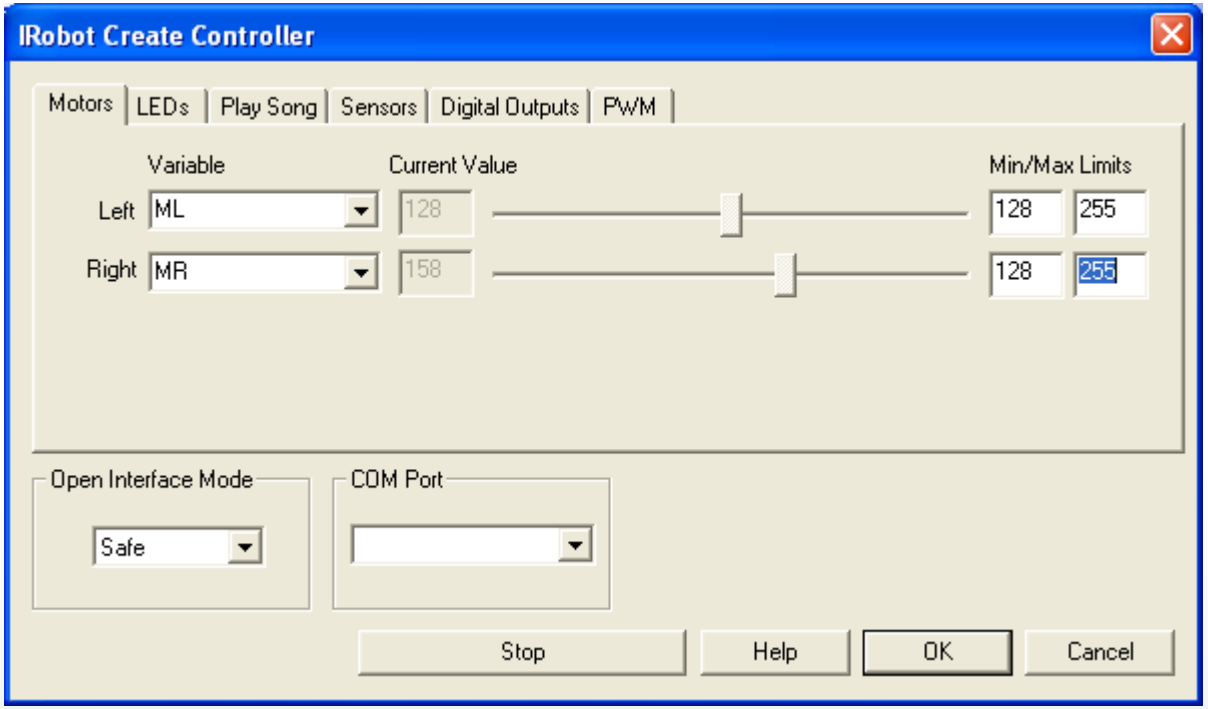

In older versions of RoboRealm, this box was too big to fit on an 800x600 display.

The RoboRealm program is just XML

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```
<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>10000</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>
  <source_mode>gui</source_mode>
</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>
  <start_oi_mode>2</start_oi_mode>
  <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>
  <digital_out_3_value>FALSE</digital_out_3_value>
  <pwm_2_max>128</pwm_2_max>
</IRobot_Create>
```

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- RoboRealm web site: http://www.roborealm.com
- RoboRealm Help http://www.roborealm.com/help/
- iRobot Create information: http://www.irobot.com/filelibrary/create/Create%20Manual_Final.pdf

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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*

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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

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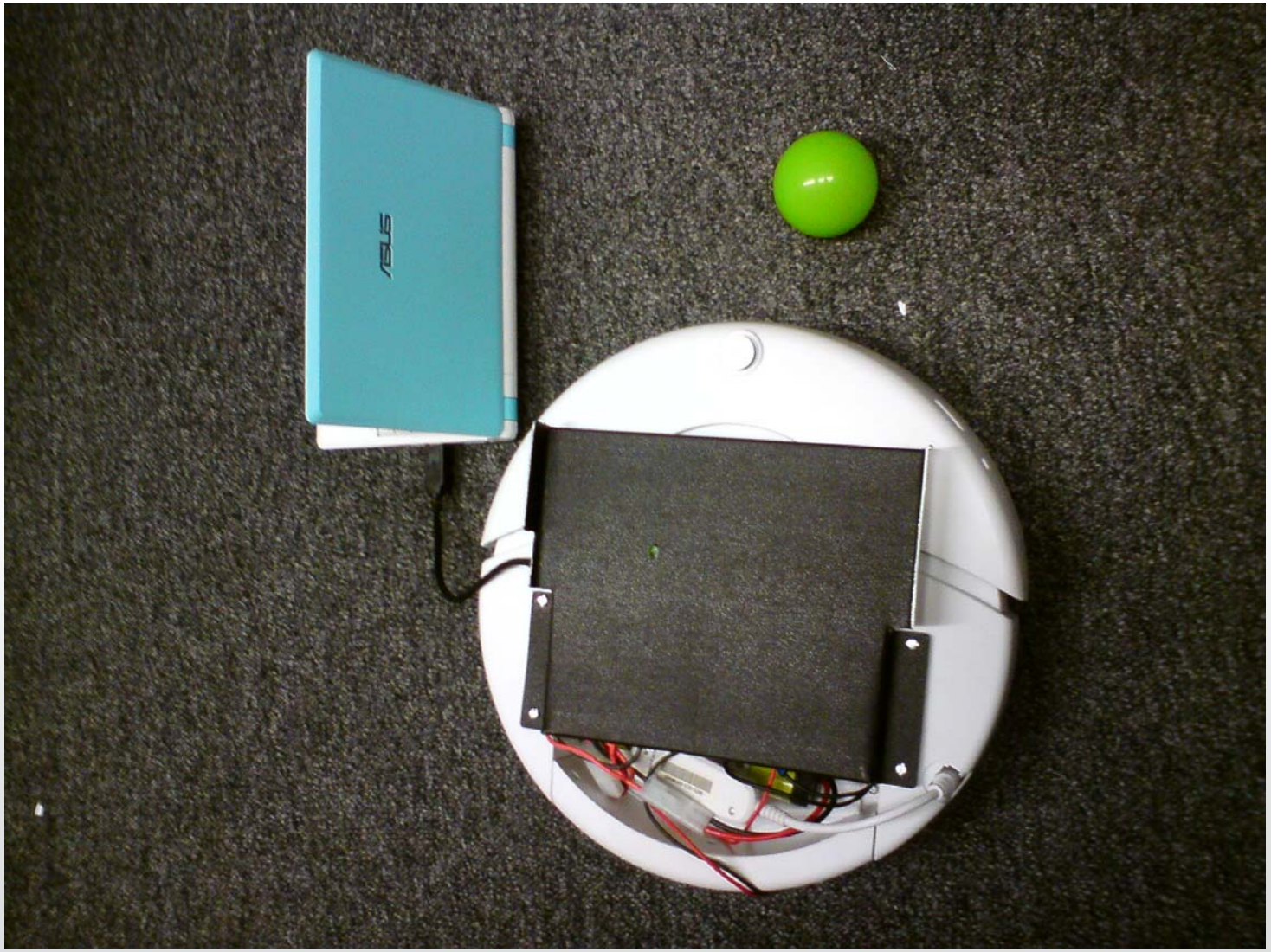

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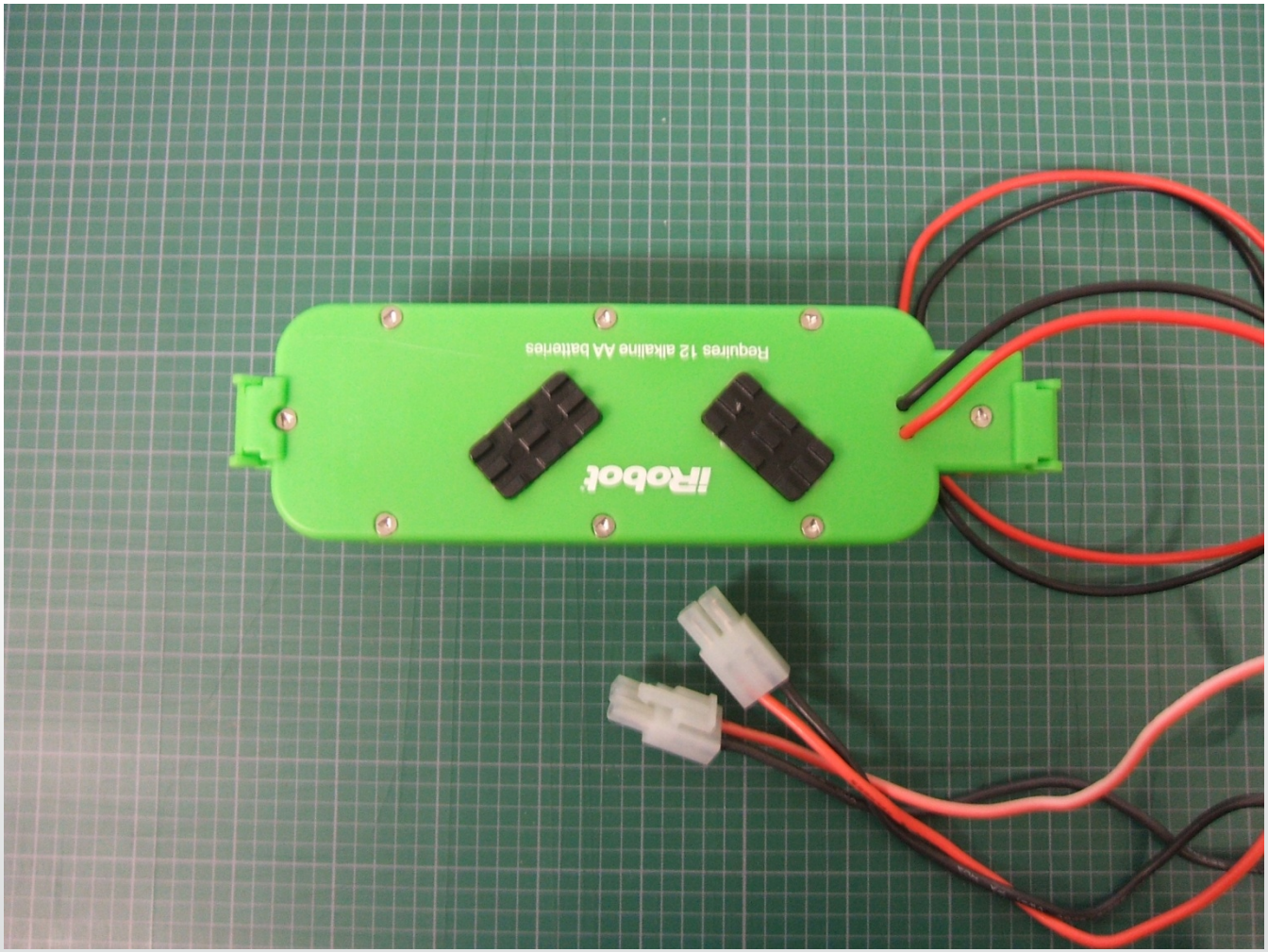
Modified Battery Case

Just connect to the internal terminals. This is *much* easier than opening up the robot



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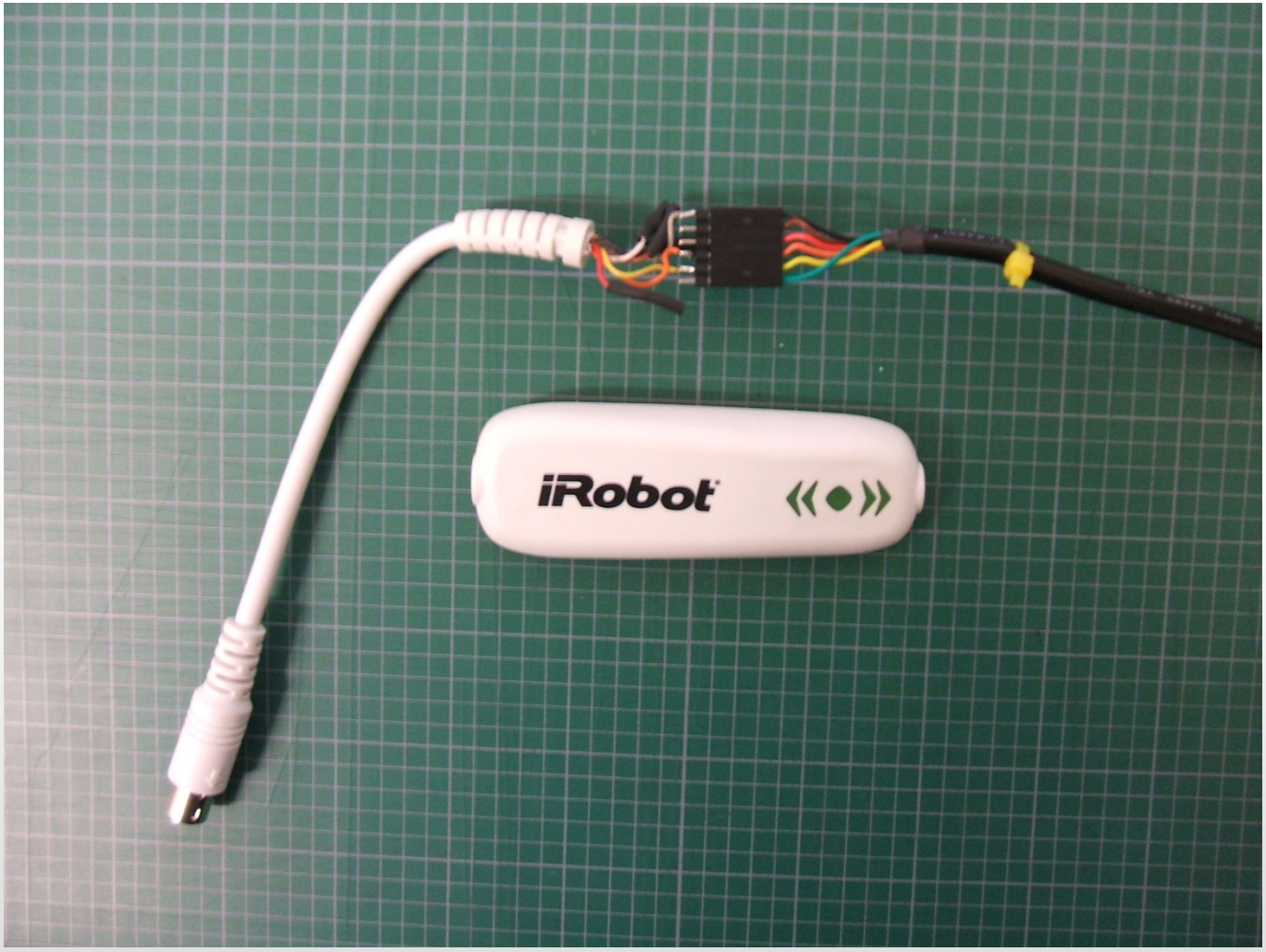
USB lead



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Hardware parts

- USB to low voltage serial converter—parts from Farnell (onecall)
  - 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)

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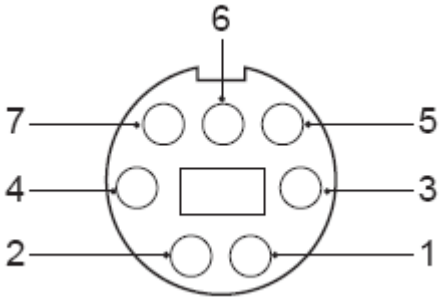
Connections for the USB port

Mini DIN	#4814 cable		USB adaptor
6	grey	----	black
	n/c	----	brown
	n/c	----	red
3	orange	----	orange
4	yellow	----	yellow
	n/c	----	green
	red		n/c
	brown		n/c
	white		n/c
	black		n/c



Top view of female DIN connector in iRobot

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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.