Interactive digital whiteboard with a Nintendo Wii remote controler and infrared LED pen. For schools HOWTO

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Author: Dirk Schouten [schoutdi (at) knoware (dot) nl], Public Primary School Rosa Boekdrukker, Amsterdam, the Netherlands http://rosaboekdrukker.net.br

NOTICE:

Since summer 2009 a newer version is available on http://wyxs.net/web/wiiscan/
This version is still useful for reference and creating IR pens.

Contents

1. Introduction

Interactive digital whiteboards are rather expensive for most schools, costing between € 2000 and € 3000. If your school has many classrooms, chances are you cannot equip all your classrooms. with such a device.

However, there is a DIY alternative. For about € 50 to € 100 and the costs of the beamer[1] you can create a fully functional interactvie digital whiteboard. Its functionality is certainly comparable with commercial equivalents.

Apart from the low costs, there are other advantages:

- Yo are free to choose the size of your whiteboard.
- Platform independence. You can use Linux, Mac, BSD, Winodws, or any other OS.
- Yo can write on your witheboard with whiteboard markers.
- Your whiteboard can --practically speaking-- not be damaged.
- There are tons of software for whiteboards.
- Other advantages? Please help.

This HOWTO describes, in a step-by-step way, how to make use of the Nintendo Wii remote controller to build a fully functional digital whiteboard for a classroom. It describes how to build an infra-red LED pen, how to power the Wii controller 'remotely', how to synchronise the Wii and finally it shows the practical setup in a classroom. We conclude with some useful links and wishes for further improvements.

The intended target audience for this HOWTO are teachers in normal schools. We have done our utmost to keep this HOWTO as simple as possible. Comments, additions, tips, etcetera are most welcome.

1.1 Credits and acknowledgements

The HOWTO is inspired by a demonstration by Johnny Chung Lee: "Creating tech marvels out of a $40 Wii Remote". The demo can be seen on: http://www.ted.com/talks/view/id/245. Johnny's marvel is a great step forward in the use of helpful techniques in education.

Lukas Reinhart from Külsheim, Germany, http://www.2style-graphics.de/index2.php?show=about, did a great job in making a program to easily connect the Wii remote controller. This program facilitates the day to day use in the classroom of Wii digital whiteboard softeware. No source available. License?

Boon Jin Gho's "Wiimote Smooth Board". Based on Johnny's and others software. Lots of really useful features -- for educational purposes-- and a good manual. See http://www.boonjin.com

Thanks are due to many participans in the Wiimote Project Forum on: http://www.wiimoteproject.com/.

Several companies have been very helpful in assisting us with this project. PC Dokter in Amsterdam, the Netherlands: Mattijs for kicking off the startup and further help and advice. EBV Elektronik in Maarssenbroek for kindly supplying a couple of high power IR leds; Carol wanted to help education. Radio Rotor in Amsterdam for

kindly supplying a couple of high-power IR leds: Carol wanted to help education. Radio Rotor in Amsterdam for the voltage regulator that was so difficult to find: Kees did it. Most parts for this project were bought there.

1.2 Warning!

Parts of this HOWTO require you to open the Wii controller, to break the warranty and, maybe, ruin the controller. Neither the author, nor the Public Primary School Rosa Boekdrukker can be held responsible for any damamage, either direct nor inirect, neiter consequential, etcetera. YOU ARE ON YOUR OWN! You have been warned! No support, help or whatsoever is given on this project.

The legalese above should not prevent you from starting this project. In your school there must be pupils, parents or teachers to whom this project is a normal, doable undertaking. Show them this HOWTO and ask for help, or ask your local electronics hobby club. They will be happy to assist. Not you, but education itself.

1.3 How to do this HOWTO

Please read this HOWTO completely before starting this project.

The best practical approach to the project is to first buy the Wii, then make the pen, do the software and get everything working. If the sectup functions completely, start opening the Wii and do the cable stuff.

(top)

2. What is needed in hardware & skills

2.1 Hardware

For this project you need a Nintendo Wii remote controller, an infra-red light pen, a whiteboard or another white smooth surface, a beamer capable of a 1024 x 786 pixel resolution, a computer with Windows XP, Microsots .NET framework, the WiiremoteConnect program and the Wiiremote Whiteboard software.
Most parts can be downloaded (software) or bought (if necessary: USB 2.0 PCI card and Bluetooth dongle) or can be self made (the infra-red LED pen).
The beamer must be bought or self made [1]. To make the pen you need some electronic parts and tools, described in section 4. Infra-red pen. For the extension of the sync button and the remote powering you need some more tools and electronic parts. This is described in section 7. Further refinements

2.2 Skills

For the PC part of this project you need basic computer skills like downloading, saving, unpacking and moving files, installing simple software and creating icons.

For the making of the IR pen very basic do-it-yourself skills are useful: cutting, sawing and soldering. A basic soldering course can be found on http://www.aaroncake.net/electronics/solder.htm. And here is a Dutch site http://www.popschoolmaastricht.nl/homepage_frameset.htm?page=college_solderen.htm.

The extension of the sync button and the remote powering of the Wii need a bit more than basic skills, mainly precision and patience.

(top)

3. Preparing the PC

This section describes what to do on the PC to obtain USB 2.0 and Bluetoot and to check its functionality. When your computer supports USB 2.0 and has Bluetooth functionality on board, you might want to skip this section an proceed to section 4. Infra-red pen.

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We carried out the project on a Compaq D500, Pentium IV 1,8 GHz processor and 512 Mb of RAM. Operating System: Windows XP SP2 with all patches and fixes.

- The computer *must* support USB 2.0. If this is not the case, get a PCI extension card that supports USB 2.0. We used a 'Gembird USB 2.0 host adapter'. It has a VIA chip and 4 ports. For this project 2 ports might be necessary, depending on your needs, discussed in section 7. Further refinements.

  How to connect the PCI card:

  - Unplug the PC from mains. Remove the cover.
  - Carefully insert the USB controller card in a free PCI slot. Fix the card with a screw, close the cover, reconnect mains and start up.
  - Check if the card is found by Windows. How to do this is described in http://www.usbman.com/Guides/checking_for_usb_2.htm, where is written: "If your Device Manager shows an ENHANCED USB Host Controller, the system has High Speed USB (USB 2.0) capability".
    Our VIA USB Enhanced host-ontroller was found in the list of USB controllers.
- Obtain a Bluetooth USB adaptor (also called a 'dongle'). We use a Trust BT-2400P ultra small bluetooth 2 USB adaptor.
- Do not insert the Bluetooth dongle in the PC.
- Install the Bluetooth driver software that came with the Bluetooth dongle. Using the Trust guidelines included with the dongle was no help because the manual directions differed from what the software showed. The software installed itself with Next, Next, Finish. At a certain moment you are asked to insert the Bluetooth dongle in the PC.
- Insert the dongle. Windows reports 'New hardware found'.
- It's never a bad idea to restart Windows.
- After a restart Windows starts searching for a HID device. Check the option 'Do not search for devices' (something alike) and click [Cancel].

OK, so far so good. In the next section we will describe the making of the infra-red pen.

(top)

4. Infra-red pen

What seems the most difficult part is in reality rather easy to construct when you take time. When you are a novice in pen building, the first one will take you several hours, but the reward is high: you made your own IR pen! Building the pen is like following a receipe in a cookbook.

4.1 The ingredients

These are the ingredients for the IR pen:

- A high-power infra-red light emitting diode (LED). Infra red light is invisible for the human eye. It's more like radiating heat than light. We use the same LED as Johnny Chung Lee: a VISHAY TSAL6400. Here is the specification as PFD document tsal6400.pdf. To our knowledge Radio Shack also has a high power IR LED, Conrad also has several and many more manufacturers are on the market. By comparing their specifications with the VISHAY LED, you can find a suitable one. Take one that uses 1,5 volt.
  Here is a picture of a LED and how it is symbolised in electronic wiring diagrams:
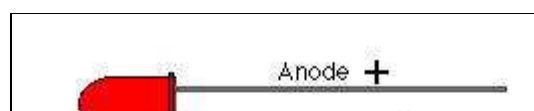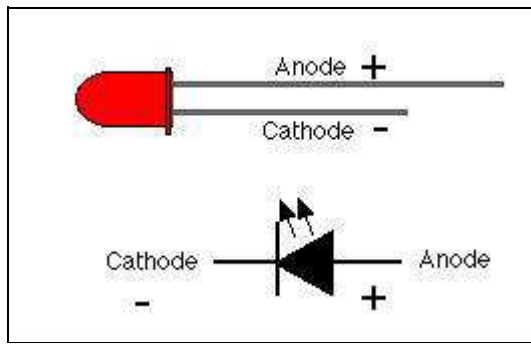
symbol_led.jpg[2]

- A 1,5 Volt AA Alkaline battery. You have seen it many times, so no need for a picture. This is the electronic symbol for a battery.
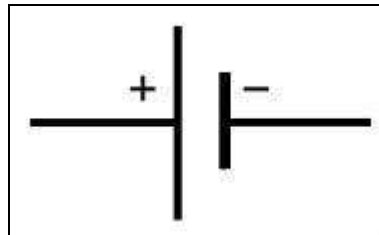

symbol_battery.jpg

- A momentary switch. Such a switch does the same as your doorbell switch. When you press the button on such a switch, the LED will go on (invisible for you, see later on). When you relesae the button the LED will stop emitting IR light. The switch simulates the left mouse button on the PC.
  Here's the symbol:
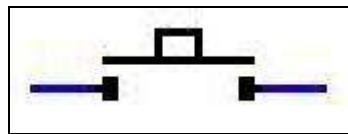
symbol_momentary_switch.jpg

- About 50 centimeters each of thin, black and red coloured, flexible, insulated wire to connect the components.
- Heat shrinkable tube to insulate connections.
- A battery holder. It's not necessary, but useful when, during a lesson, you want to replace an empty battery in your pen and you left your soldering iron at home.

The electronic components can be connected in such a way that they form a circuit. Here is the wiring diagram (the recipe in terms of the cook):
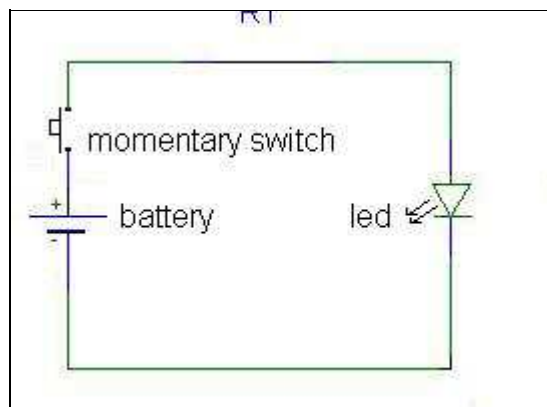
circuit_ir_pen.jpg

When the contacts of the momentary switch are connected, a circuit is formed and the LED will emit infra-red light.

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4.2 The real components

The wiring diagram tells you how to connect the parts as they lay before you on the table. These are the components that form the electroc parts in the IR pen:

Click ir_pen_ingredients.jpg to enlarge (or click on the image to open in new window)

Explanation:

1. Infra-red LED
2. AA size battery
3. Momentary switch
4. Black flexible wire
5. Red flexible wire
6. Heat shrinkable insulation tube
7. Battery holder
8. Pen

NOTICE: The pen can be 'anything'. We found a toy ballpoint. A big Edding felt marker can also be used, or anything that makes something like a pen and that can contain the battery holder, the switch and the LED. Use your imagination and visit a stationary, a beauty shop or an emporium.

Here are the tools used for the construction of the pen:

Click **ir_pen_tools_used.jpg** to enlarge (or click on the image to open in new window)

- A hand drill (an electric drill can be used too) to drill holes in plastic.
- A jigsaw or another kind of saw to saw plastic.
- A soldering iron of about 25 watts.
- Resin core solder. Do *not* use acid!
- A pair of cutter tongs. A scissor can also be used
- Some drills
- A file
- 2 components glue or other plastic glue.
- A pair of tweezers to hold small components
- A rubber band to tighten around the pair of tweezers to have one hand free.

4.3 Making a test IR pen

Here is the basic wiring, just to show everyting in one picture.
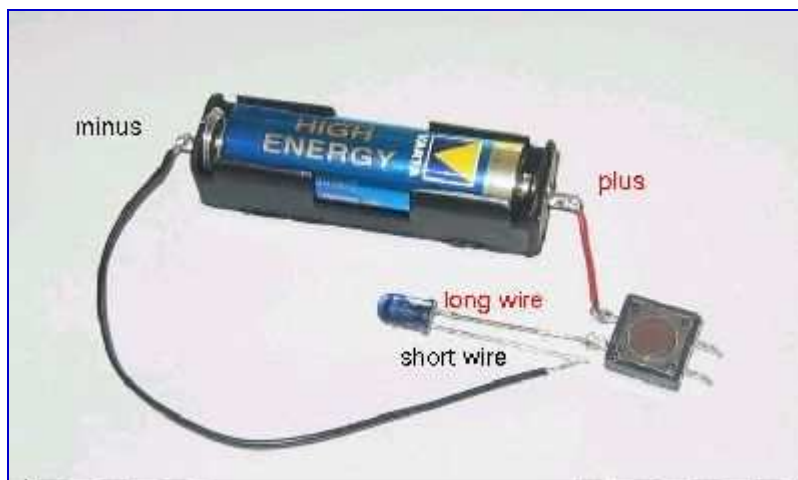
Click **ir_pen_battery+switch+led.jpg** to enlarge (or click on the image to open in new window)

Maybe it's an idea to first build this basic circuit and test it. It's a good practice for the real work. Your momentary switch might have only 2 connections. Ours came with 4, so 2 remained unused and could be cut off. The most difficult part here is observing the wire lengths on the LED and connecting the right wire to the right part..
NOTICE: A tip on soldering the LED. A LED is a bit sensitive to the heat of the soldering iron. With the pair of tweezers on the LED pins you can reduce the heat flowing to the LED via the pins:
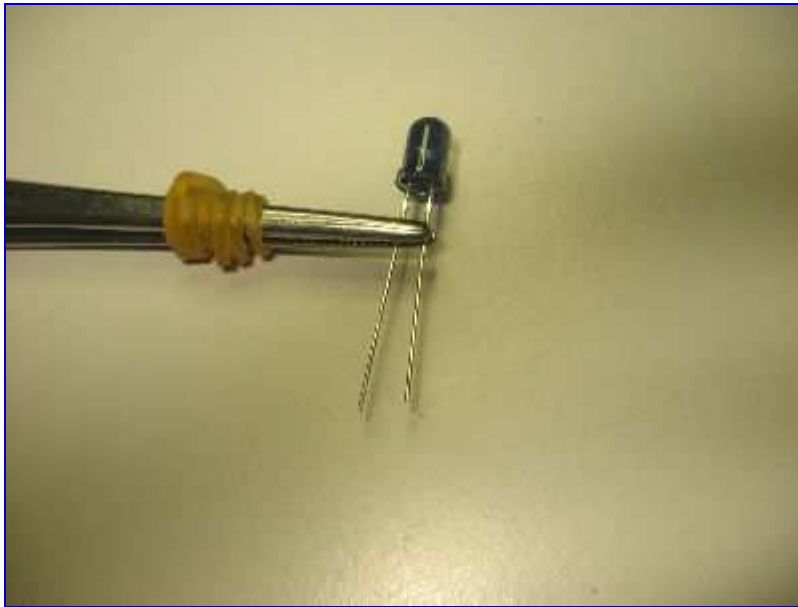
Click ir_pen_led+tweezers.jpg to enlarge (or click on the image to open in new window)

4.4 Testing the basic pen

The basic wiring can be checked in two ways: 1. using a digital photocamera or a camera in a cellphone or, 2. With your lips. Both methods are described.

4.4.1 Testing with a camera

Digital cameras are sensitive to infra-red light. Below is a picture of the basic circuit (believe me). The picture is taken in the dark and the momentary switch is not pressed:

ir_pen_switch_off.jpg

In the picture below the switch is pressed. The white dot proves the LED emits infra-red light, i.e the circuit is functioning.

ir_pen_switch_on.jpg

4.4.2 The lip test

This test is *not* dangerous. Your lips are sensitive test devices. Hold the infra-red LED to your lips and press the switch for about 30 seconds. Within that time you feel the emitting infra-red radiation as warmth on your lips. When you hav made an error, no heat is felt. Change the + and - to the LED.

4.5 Making a real IR pen

Now desolder the components and start building the pen. Here are a few shots from ours.

Click ir_pen_disassembled.jpg to enlarge (or click on the image to open in new window)

After removing all the parts of the pen that have to do with writing, the plan is as follows:

- Make the hole in the pen tip bigger so the LED can be glued with 2 components kit. Before gluing the LED, connect a red (+) and a black (-) wire to it and insulate them with heat shrinkable tube. Make the wires too long.
- Make a hole in the pen where the switch can be glued in. Make the wires to the switch (two red wires)long engough and insulate them.
- Glue the LED and the switch, have a drink and go to bed so the glue can harden for many hours.
- Solder the wires.
- Assemble and test the pen.

- Assemble and test the pen.

Click [ir_pen_led+wires+shrink.jpg](#) to enlarge (or click on the image to open in new window)

The shrink tube is shrinked by gently moving the hot part of the soldering iron to all sides of the tube.

As can be seen on the specifications sheet, the LED has a diameter of 5 mm. With three drills (3 mm, 4 mm and 5 mm) we enlarge the hole in the tip. The plasitc easily breaks so that's why the 3 drills.
When trying to fit the led, too much force is needed, so a 5.5 mm. drill is used to enlarge the hole for another 0,5 mm. Trying again, the LED won't come out of the hole far enough. With a file the rim of the LED is removed. Now the LED fits perfectly.

Click [ir_pentip+led.jpg](#) to enlarge (or click on the image to open in new window)

Now for the hole in the pen.

Click ir_pen_switch_hole.jpg to enlarge (or click on the image to open in new window)

With a saw and the tip of the soldering iron a hole is made. Yes, we know it's bad for the tip and we will clean it immediately after this operation and put some solder on the tip. With the file the hole is made square to fit the momentary switch.

ERROR: There is an error in the picture below! Both wires must be red.

Click ir_pen_switch_wired.jpg to enlarge (or click on the image to open in new window)

The switch is wired and can be glued in the pen.

Click ir_pen_complete_open.jpg to enlarge (or click on the image to open in new window)

The pen is ready to be assembled. Test the pen as earlier described.

4.6 Yet another pen

Below is a picuture of another pen we made. Looks more like the old fashioned piece of chalk:

Click ir_pen_piece_of_chalk.jpg to enlarge (or click on the image to open in new window)

4.7 Pressure sensitive pen

Under construction.

(top)

5. Software

This section descrbes the installation of the .NET software, the WiimoteConnect software and the Whiteboard software.

5.1 .NET Framework

5.1 .NET Framework

If not installed, download the 'Microsoft .NET Framework Version 2.0 Redistributable Package (x86)' from: http://www.microsoft.com/downloads/details.aspx?FamilyID= 0856EACB-4362-4B0D-8EDD-AAB15C5E04F5&displaylang=en. (too long URL splitt)

Accept the license agreement and install the software.

We could not find a *simple* test to check if the software was properly installed.

5.2 Wiimote connect

Download the WiimoteConnect software that will faciltate the procedure to connect the Wii Remote via Bluetooth here: http://www.2style-graphics.de/wiiconnect/WiimoteConnect-0.5.rar. Download the WiimoteConnect-0.5.rar file.
NOTICE: .rar is a compression format, like .zip. It must like .zip files be unpacked, for example with 7-Zip from http://www.7-zip.org/. Details on WiimoteConnect program can be found on: http://www.wiimoteproject.com/wiimote-and-bluetooth-connectivity/ wiimoteconnect-searching-beta-testers-update-please-test-it-t954.0.html. (too long URL split)

5.3 Wiimote Whiteboard

Johnny Lee also has a project page at: http://www.cs.cmu.edu/~johnny/projects/wii/ were you can find a description and downloads for the software. Download and save the WiimoteWhiteboardv02.zip file.

Unzip, unrar and install the Wiiremoteconnect software and the Whiteboard software in 2 directories on your computer and create two desktop icons: 'WiimoteWhiteboard' and 'WiimoteConnect'.

You are now ready for the real thing, piecing it all together. That's handled in the next section.

(top)

6. Here we go

You need the PC with the software, a beamer, a whiteboard, the Wii remote controller and the IR pen. First you have to determine the right place for the Wii, then you can, via Bluetooth, connect PC and Wii.

NOTICE:
You can also test without a beamer by using an LCD screen. Do not use a CRT monitor. The radiated heat from the screen may give unpredicatble results.

6.1 The right place

Proper plcaemt of the Wii controller is vital to precision in resolution, i.e. the practical work with the whiteboard in the classroom. When the controller is too close to the screen the four calibration points will not be seen by the IR camera in the Wii controller. When the controller is too far away, the calibration points will be found with ease, but you loose on tracking resolution. This can be demonstrated by opening a paint program and using a ruler (a real one, not a virtual) to draw a straight line on the whiteboard.
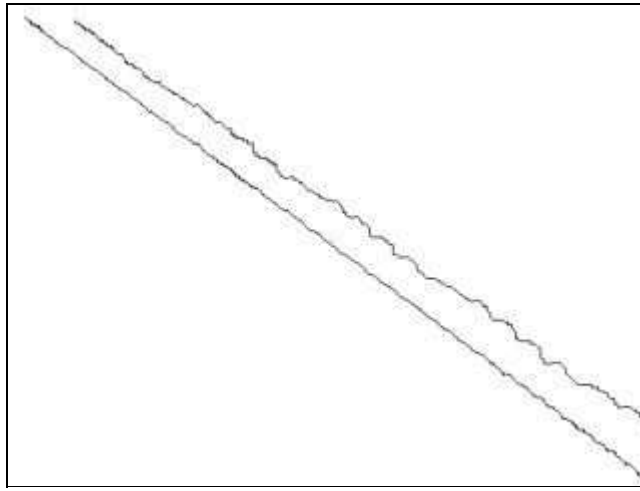
resolution.jpg

The difference is stunning! Here are the facts:
The beaamer screen area on the whiteboard is 1.60 meter wide. The real straight line is about 85 cm. long and is drawn from center screen to lower right corner.
With the straight line, the Wii is placed at 2.10 meters distance from center screen, about 65 centimeters above the beamer, so facing the whiteboard at a 90 degrees angle.
With the 'not so straight' line, the Wii is placed at a distance of 3.30 meters from center screen, aside from the beamer in an angle of about 45 degrees with the beamer.
The IR camera seems to have a 45 degrees horizotal viewing angle. When attaching the beamer to the ceiling, placing the wii in the neighbourhood of the beamer facing the projection field at such a distance that the viewing angle of the camera is optimally used. You can perfectly use Boon Jins program to precisely find the best place for the Wii. His program also has a line smoothing function.

6.2 Connecting

- Start the beamer
- Start the PC
- Login (we did everything as admin)
- Double click the WiimoteConnect icon. The WiimoteConnect program window opens.
- On the Wii Remote, press the buttons 1 and 2 simultaneously. The 4 blue leds start blinking. Keep on pressing until you read 'stop pressing'. If the leds stop blinking, press again.

  Alternative way: release the battery cover and press the red sync button once. The 4 leds start blinking.

- In the WiimoteConnect program press the 'Connect' button *once*. The button gets grayed out.
- A Windows message appeared 'New hardware found Bletooth HID-device' and, if sound is configured, the computer speaker blurbs 'Plop'. The message disappears. When you have pressed the red button, the leds may trun off. Press the red button again.
- A new Windows message appears 'New hardware found. The new hardware is installed and can be used'. Teh speaker says 'Plop'. The message disappears.
- A last Windows message appears 'Connected. Wiimote successfully connected!'. Speaker plops. This message stays some time. Let it disappear, it takes some time.
- Stop pressing the 1 and 2 buttons. The 4 leds keep blinking. Also when you pressed the red sync button, the 4 leds keep blinking.
- Now we start the Whiteboard program by double clicking on the 'WiimoteWhiteboard' icon. The WiimoteWhiteboard program window opens. Now only the left led light blinks on the Wiimote.
- Put the Wiimote in a plcae where it can see the the entire computer screen. Bear in mind that the IR camera has a horizontal angle of about 45 degrees. Our beamer image is about 1.70 meter wide and the Wii Remote is at a distance of about 3.30 meter from the screens center. It was mounted on a height of about 2 meters in a 45 degrees angle with the whiteboard.
  NOTICE: as earlier described, this is not the best place for the Wii, but it will do for a start.

- Have your IR pen ready.
- With your computers left mouse button, click *once* the button 'Calibrate Location [Wiimote A' in the Wiimote Whiteboard program.
- The computer screen becomes white. In the upper left corner of the screen a red crosshair can be seen.
- Put the tip of your IR pen precisely on the center of the crosshairs and click *once*. The crosshair moves to the upper right corner of the screen. Repeat click once. Repeat for bottom left and bottom right. When the 4th crosshair is done, the white screen disapears and the Windows desktop is visible and the digital whiteboard is usable.
- You now have a light pen simulating your left mouse. Practice a bit to get the hang of it. For examplel go: Start > Programs > Accessories > Paint and enjoy your digital whteboard.
- Finished.
- NOTICE: Every time you start your PC, you have to repeat the connection procedure.
  NOTICE: When working with the pen it seems easier to reduce the double click speed.

6.3 Checking

It's not necessary, but here is a checking procedure to see if the devices are added:

- Go: This Computer > System properties > Tab: Hardware > Item: Hardware Device Management > Click button: Device management. The list of devices opens.
- Look for Human Interface Devices (HID).
- Click the + sign to expand the HID list.
- Two items should be visible:
  -Bluetooth HID-device (the Trust Bluetooth dongle)
  -HID compliant game controller (the Wiimote controller)
  In our setup these two devices have to be there. Otherwise, starting the calibration software gives errors like: "Wiimote Whiteboard has encountered a problem and needs to close. etcetera" or, "Exception: Wiimote not found in HID device list".
  Start over and try to add the Wii remote again. You should see the 3 Winodws messages mentioned earlier.

Another check:

- Check the Wiimote connection by going: This computer > Change Setting > Configuration > Bluetooth > Window: Bluetooth devices > Tab: Devices.
- The device must be visible as: NINTENDO RVL-CNT 01, No Key, Connected.
- If not visible, here is a cumbersome method to add the device.
- Click: Add. The winodw 'Wizard add Bluetooth device' opens. Check: 'My device ... can be found' > Click: Next. The search window opens.
- On the Wiimote, press buttons 1 and 2 simultaneously and keep pressing them. The 4 blue lights on the controller keep on flashing. Keep pressing buttons 1 and 2.
- Keep pressing buttons 1 and 2. Now the device must be found. If necessary press the 'Search again' button in the 'Bluetooth add device wizard' window.
- Keep pressing buttons 1 and 2. The device is found. Select the device: NINTENDO RVL-CNT 01, press 'Next'.
- Keep pressing buttons 1 and 2. In the next window, check 'No passcode'. Press 'Next'.
- Keep pressing buttons 1 and 2. In the next window: 'Install Bluetooth device', press 'Finish'. You have returned to the 'Bluetooth devices' window. Press 'OK'.
- Pff!! Release buttons 1 and 2.

This is not the preferred connection method in a classroom environment.

7. Further refinements

In a classroom a teacher sometimes moves a bit hand and fire data as well and the Wiimote will be fired to the ceiling

In a classroom, a teacher most times uses a whiteboard fixed to a wall and the Wiimote will be fixed to the ceiling, just like the beamer. In this environment it's a bit clumsy to every day find a ladder, climb to the Wii, press some buttons and have another teacher start the WiimoteConnect program. The same goes for changing the batteries. In this section we will see if we can do better.

Below are the next steps to take in this project. You have to take your schools Wiimote apart and solder a few wires in it. The wires connect to the red sync momentary switch under the battery cover and connect to a remote switch to solve the daily ladder problem. The empty battery problem is solved by connecting wires to the battery joints and power the Wiimote via an AC adaptor or the USB port on the PC.

Here are the steps to take.

7.1. Opening the Wii remote controller

This section describes how to open the Wii remote controller and attach wires, so the red synchronise button can be operated from a distance and an external power source can be used to replace the batteries.

- Open the battery cover and remove the batteries.
- Four screws are visible; 2 at the rear of the Wii, the third and fourth one are located under the (now removed) batteries. The fourth screw is covered with a sticker. This is to ensure you lose your warranty when continuing this project. Stop now or proceed.
- Put the Wii on the table, the buttons facing the table.
- With a No. 4 TORX screwdriver, also known as a 'star screwdriver' or 'star bit' remove the 4 screws. Put them in a safe place.
- Carefully lift the bottom of the wiimote. Start at the rear end. The front side, near the camera does not disassemble. On the the front side of the wiimote cover 2 clips are attached that hold the bottom in place. Applying force the wrong way will break off the clips.
- Lift up the rear side a little bit then stick a blunt, round tipped, thin table knife sideways between the bottom and the cover to release the clip. Carefully move the knife from the rear to te front util the bottom and cover separate on that side.

Click wii_open_with_knife.jpg to enlarge (or click on the image to open in new window)

Do the same on the other side and keep the bottom and cover toeterh to prevent pieces falling out. Put the Wii on the table, the cover facing the table and and then lift off the bottom. In this way the buttons, speaker and rubber pieces will stay in place.

To reassemble the Wii, adjustable joint pliers may be useful to press the clips together a bit while pressing the bottom and cover together:

Click **wii_adjustable-joint_pliers.jpg** to enlarge (or click on the image to open in new window)

Whatever happens during the opening of the Wii, nothing to worry if the clips break off and/or the buttons fall on the table. It's easy to reassemble and two drops of glue in the final stage of the project will solve the missing clips problem. We use a Wii without clips.
So, on the table lies the cover, buttons, the speaker, plastic and rubber stuff. Here are some pictures to show the inside. The two pictures below are taken from another Wii than all other pictures of the Wii's inside.

Click **wii_components_side.jpg** to enlarge (or click on the image to open in new window)

Click wii_printed_circuit_board_side.jpg to enlarge (or click on the image to open in new window)

- To make the sync button and the powering of the Wii external, you need the following materials:

Click wii_remote_sync+power_components.jpg to enlarge (or click on the image to open in new window)

- 10 meters (large classroom) of thin flexible 4 wire cable. Mine has 4 colors: red (+ 3 Volt), blue (- 3 Volt), green and yellog (sync switch).
- 1 momentary switch for the sync button
- 1 on-off switch for the battery power. This switch seemed unnecessary in later prototypes. If necessary, this switch can be omitted.
- An enclosure. We found a plastic box of 5 x 7,5 cm.
- An AC power adaptor or an USB cable. They are not in the picture and will be discussed below when we power the Wii remotely.
- The electronic parts to regulate the power are also not in the picture and will be discussed below.
- This is the circuit side of the Wii's printed circuit board. The location of the switch and the 4 joints can be seen, as well as the 2 places where the + and the - of the battery connections are soldered on the print. Enlarge the picture to study details, texts and symbols.

Click wii_pc_board_switch+power_locations.jpg to enlarge (or click on the image to open in new window)

- In the rear side of the Wii, drill 3 holes with a 2 mm drill. Enlarge the middle hole to the diameter of the cable. See pictures for details. Yes, one drill is 1 mm. just for the picture.
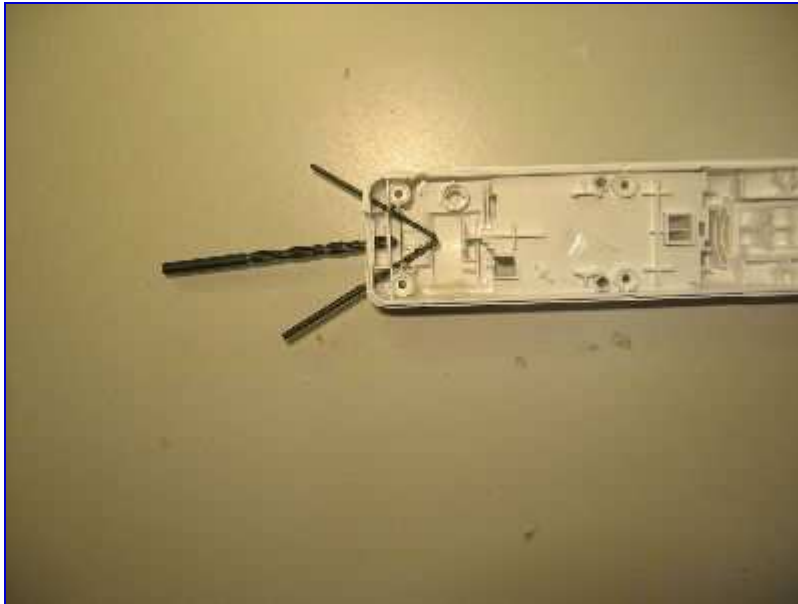
**Click wii_bottom_holes_topview.jpg to enlarge (or click on the image to open in new window)**

Our middle hole is not exatcly in the middle. Not on purpose, just Lack of precision. You can do better.

Click wii_bottom_holes_rearview.jpg to enlarge (or click on the image to open in new window)

- Enlarge the hole in the middle with a ... mm. drill (diameter of cable, ours is 3.2 mm.) so the 4 wire cable fits neatly in the hole. Later on you can glue the cable to the plastic if necessary.
- with a cutter, remove material so the wires can be bend (see picture below).
- With the side of your soldering iron, 'cut' the cable insulation. This is to prevent accidental damaging of the insulation of the four wires. 'Cut' about 20 (twenty) centimeters of insulation. In case it's impossible to cut such a length in one go, do it in stages.
- Put the 4 wires trough the middle hole and gently press the cable through the hole. Bend the yellow and green pair and the red and blue pair according to the picture. Please bear in mind that there is *very* little room in the Wii. No need to trim the wires yet.
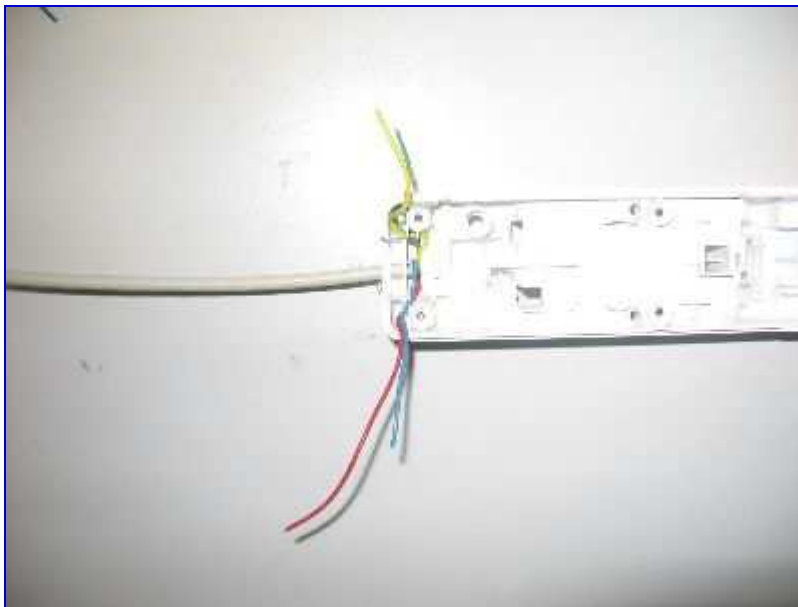
Click wii_bottom_wired.jpg to enlarge (or click on the image to open in new window)

- In the Wii cover, remove the thin white plastic as shown (black '<') to make room for the wires.
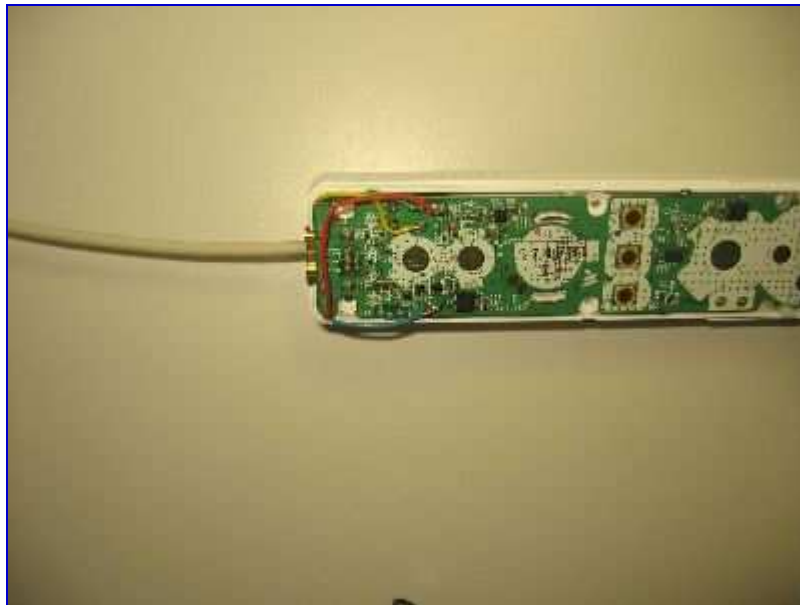
Click wii_cover_cutter.jpg to enlarge (or click on the image to open in new window)

- Solder the four wires. Solder as quickly as possible in order to prevent overheating of the printed circuit board, components or other soldered joints. The 2 joints on the baattery need a bit more time in heating than the two joints on the switch. If you do not trust yourself here; no sweat. You have done everything. Ask someone with a bit more experience. There are many and she/he will do this job in 5 minutes. Or, an even better alternative, rise early, find an old radio in the trash on the streets, open it, practice on the printed circuit board inside and become an expert yourself.
  This is the result:

Click wii_pc_board_4_wires.jpg to enlarge (or click on the image to open in new window)

The 4 wires are connected and bend in such a way that the cover can be replaced.

- Put a couple of matches on the table and put the Wii cover (buttons facing the table but not resting on the table because of the matches) and carefully put the Wii bottom with the printed circuit board over the cover and *gently* press the two together. Some fiddling with the wires may be necessary because the is hardly any room for the wires. When you have replaced the cover and all fits well without force, use a couple of rubber bands to hold the parts together for the time being.
- Insert the two batteries. Do not use the battery cover for now.
- **Testing**.
  Before replacing the 4 screws, make sure everything is still working inside the Wii and at the other end of the cable. Test as follows:
  - Test the Wii. Are all buttons on the cover still functioning? Is the sync button still functioning?

- Test the Wii. Are all buttons on the cover still functioning? Is the sync button still functioning?
- Test the connections to the sync button. At the other end of the 10 meter cable, strip a bit of the insulation of the green and yellow wire and, just for testing, solder the two contacts of the momentary switch on them. Press the switch. The four leds should flash.
- Test the connections to the batteries. Strip the red and blue wire and, using a voltmeter, check if you find about 3 Volts on the wires.
- Final test with the Wii and the PC. Is everything still functioning as before?
- Find the 4 screws, insert and tighten them (not too hard!). Test again if everything functios as before. The red sync switch should still work as normal and all the buttons on the Wii should funcion as well. If you wish, you can use two drops of glue to replace the 2 plastic pieces that came off during the disassembling of the Wii. It's not necessary.
- Have a drink and congratulate yourself. The toughest part is over. The rest is a piece of cake.

NOTICE: There are many alternatives to this operation. Here are a few suggestions:

- Remove the sync switch. Desoldering it using litze wire or a desoldering pump. The hole for the red button can be enlarged and used for the 4 wire cable. Insert the wires from the components side of the printed circuit board. This seems an elegant solution.
- Do not open the Wii at all but cut a hole in the cover to reach the switch. Not hat elegant.

There must be more and/or even better ideas to circumvent the ladder problem.
YES! There are. Adri came with the idea to replace the cable soldered to the Wii and the printed circuit board. Use RJ-11 connectors (Registered Jack, 4 pin telephone connector). Glue one in the cover of the empy battery compartment of the Wii and the other in the PCboard enclosure. Buy or make a cable on the right length with 2 RJ-11 connecors. Not tested.

Now the other end of the cable must get it's final destination. This is treated in the next section.

7.2. Powering the Wii

To remotely power the Wii you can choose two solutions: an AC power adapter or powering the Wii via USB. The Wii needs 3 Volts DC (Direct Current) or less. Alkaline batteries provide about 1,5 Volt. Nickel cadmium or NiMh cells provide 1,2 Volt. It seems important not to overpower the Wii, so we use a voltage regulator to keep the voltage at 2.85 volts. This makes the use of the power source less critical. An AC adapter, laying around in the school or at someone's home, supplying 3 to 7 Volts is fine. The voltage regulator will bring down the voltage to 2,85 Volts.
You can also use the power that is available via the USB connectors on your PC. USB connectors supply 5 Volts. The voltage regulator will bring it down to 2,85 volts.
When working on the power supply we also make a warning light, indicating the Wii is powered. We use a red 3 volt LED.

7.2.1. Powering the Wii via USB

When your PC has more USB ports, or you found an USB PCI card with multiple ports, you can use one of them to power the Wii. An USB port has + 5 volt to power small USB devices that use little current. Here is the pin configuration of an USB connector:

USB_A_pinout.jpg[3]

USB_A_pinout.jpg[3]

Find an old USB cable from a broken device, or an USB extension cable, cut off the 'other' end and strip the insulation. Here is an example:

USB_cable.jpg

The 4 wires, red, black, white and green can be seen, as well as the shielding that protects the data transmission from electromagnetic radiation. The shielding is not needed in this project since we only use the power wires.

These are the ingredients to power the Wii via USB

Click USB_ingredients.jpg to enlarge (or click on the image to open in new window)

Explanation (of the red numbers in picture):

1. A polar capacitor of 100 µF (micro Fahrrad). A capacitor is a device that can hold and release current. Polar

1. A polar capacitor of 100 µF (micro Fahrrad). A capacitor is a device that can hold and release current. Polar means it has a + and a - side. This is the symbol for the 2 polar capacitors we use:
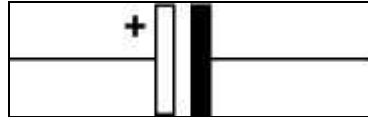
symbol_polar_capacitor.jpg

In the shop they will ask you: "What voltage?". Answer:"Above 20 volts or so, whatever you got if it's small". The same goes for the other capacitor.

2. A voltage regulator. It's an electronic part that can bring a high voltage down to a lower value. This is the symbol:
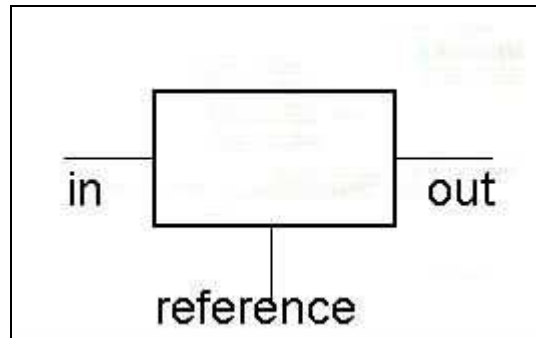
symbol_voltage_regulator.jpg

We use an LM 1117DT 285, manufactuired by National Semiconductor. It can bring voltages not higher than 7 Volt down to 2.85 Volt. In the specification sheet lm1117.pdf you can find all details including wiring diagrams.

Explanation (of the white numbers at the LM1117DT 285 in the picture USB_ingredients.jpg):

1. Reference. Connects to - (minus or 'ground'). Both the minuses from the USB connector and the Wii battery are connected to this pin.
2. Out. Connects to the Wii with + 2.85 Volts. The same 'pin' can be found on top of the regulator, so it has the same number. We will use that 'pin' to facilitate soldering and to fix the regulator on a piece of printed circuit board.
3. In. This pin connects to the red + 5 Volt wire on the USB cable.

3. A polar capacitor of 10 µF. See above for details.
4. A resistor of 60 Ohm. Because of the voltage of 2,85 Volts you cannot directly connect the LED. The resistor, set in series with the LED, reduces the current the LED gets. This is the symbol of a resistor:
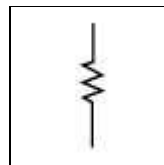

symbol_resistor.jpg

5. A plain ordinary 1,5 Volt red LED. You know the symbol from the IR pen.
6. A piece of printed circuit board. It will b eused to solder the components and wires on. We bought a piece of 5 x 10 centimeter. Enough for about 5 classrooms.

NOTICE: The LM1117DT 285 is chosen because it needs no adjustments or extra parts and it makes the voltage supplied to the Wii less critical.
There are many alternatives for the LM1117 DT285 voltage regulator. You could use a adjustable voltage regulator, or two resistors of fixed values, or one adjustable resistor, but then you have to find the correct values of

regulator, or two resistors of fixed values, or one adjustable resistor, but then you have to find the correct values of the resistors yourself and, IMHO, you end up with a poor design that's not stable enough for use in schools.

Here is the electronic circuit diagram:
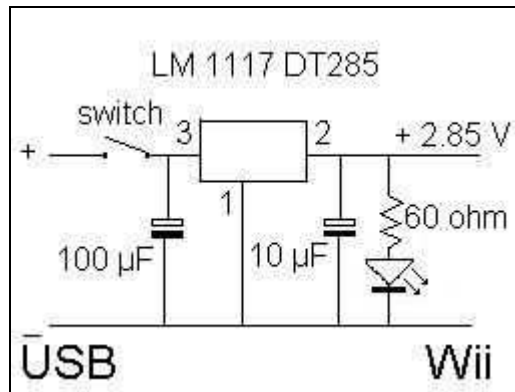
circuit_usb_power.jpg

And this is the plan:

- Make a drawing on how the components will be soldered on the pc board
- Prepare the pc board
- Solder the components on the board
- Prepare the enclosure, i.e. drill holes etc.
- Prepare switches, LED and USB- and Wii cables
- Solder everything except the power connection to the Wii.
- Test the circuit
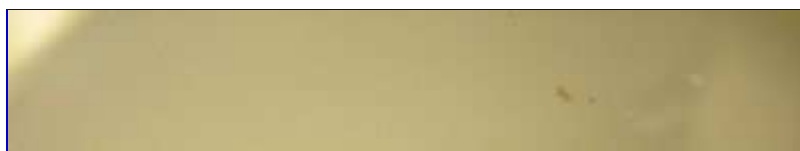- Connect the power to the Wii.
- Test again.

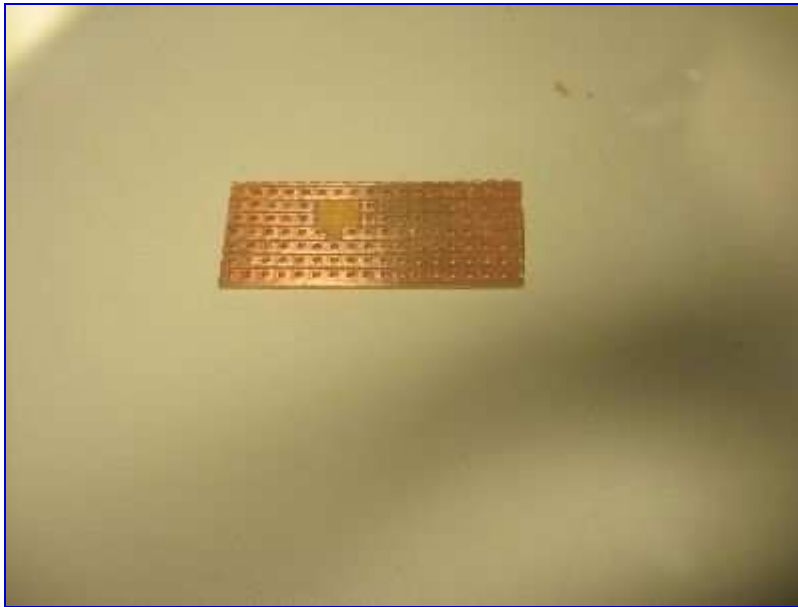Here we go, this is the execution:
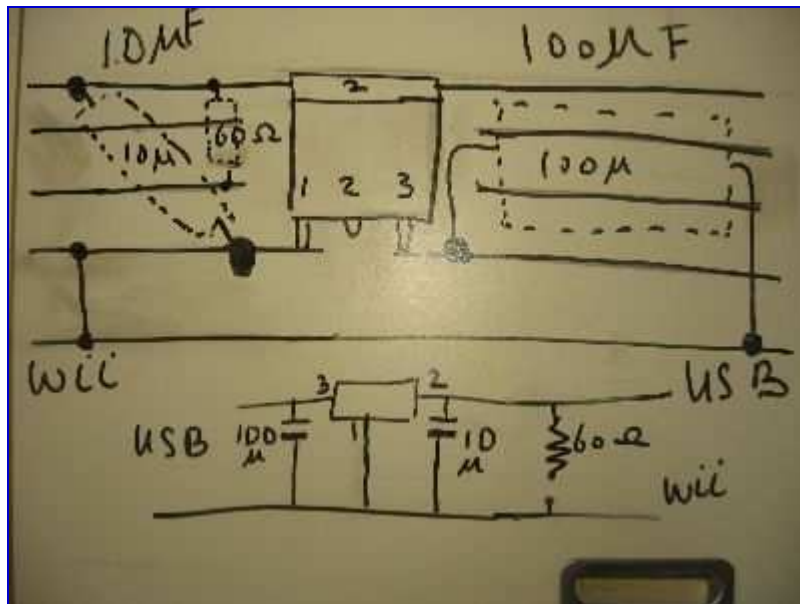
Click USB_power_design.jpg to enlarge (or click on the image to open in new window)

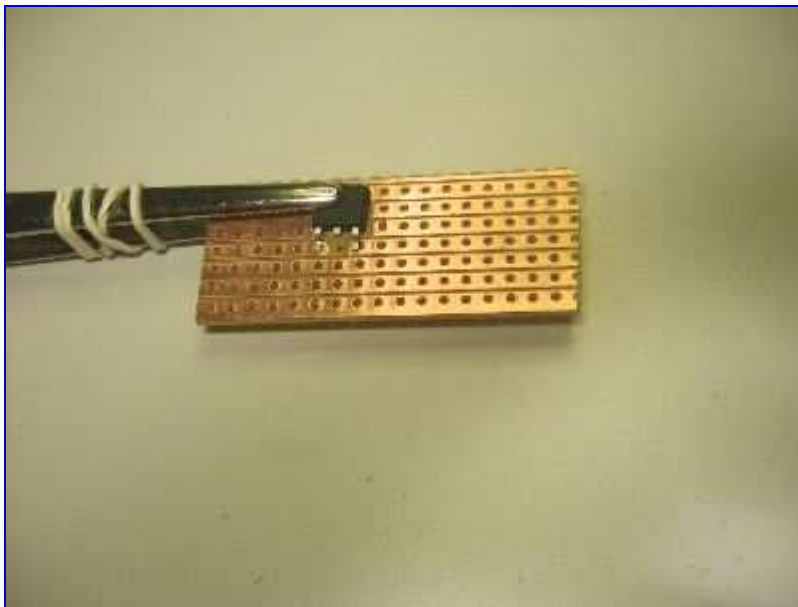As you can see we also put the 60 Ohm resistor for the LED on the PC board.
With a 4 mm. drill, by hand the copper is removed and with a sharp cutter the remains are removed.

Click USB_power_pc-board.jpg to enlarge (or click on the image to open in new window)
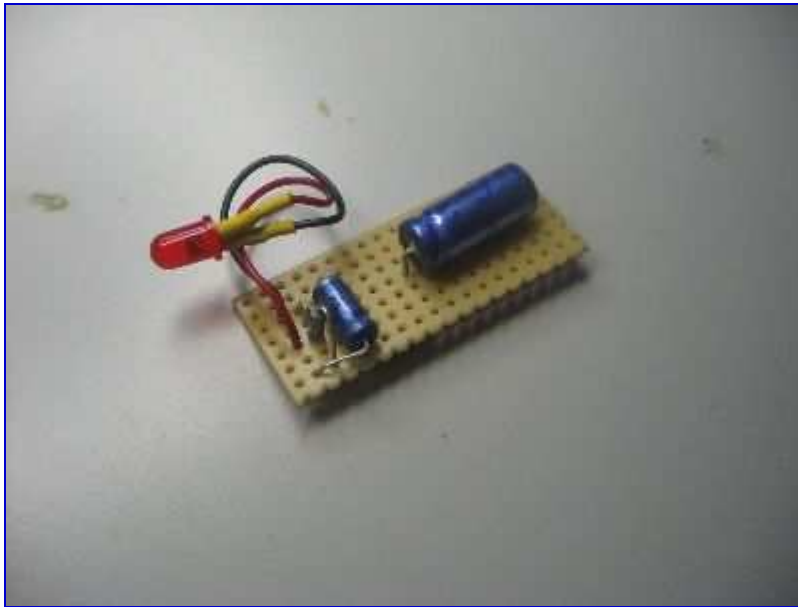
With a pair of tweezers and a rubber band the voltage regulator is held in position, ready for soldering.

Click USB_power_pc_board+voltage_regulator.jpg to enlarge (or click on the image to open in new window)

The capacitors and the LED are mounted on the other side of the pc-board.
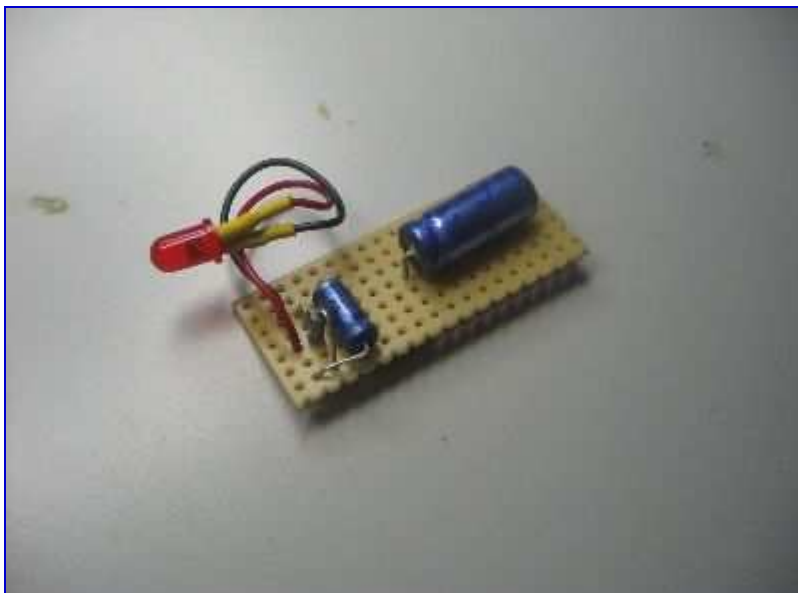
Click USB_power_pc_board_ready.jpg to enlarge (or click on the image to open in new window)

ERROR! The 60 ohm resistor is not soldered on the pc board. You can see the resistor in the picture 'enclosure.jpg' below.
The LED is wired to the PC board. Everything is ready to connect the last parts to the board: the USB cable and wires, the on/off switch and, finally, the Wii.

• Strip about 10 cm. of the USB's cable insulation, remove the electromagnetic shielding and the cotton. Cut short the green and white wire and insulate the ends with pieces of heat shrinkable tube to prevent short circuits. Push back the insulation of the cable to the wires ending to cover the protruding shield and cotton. It should look like this: the white line in the picture indicates where the shield and cotton end.
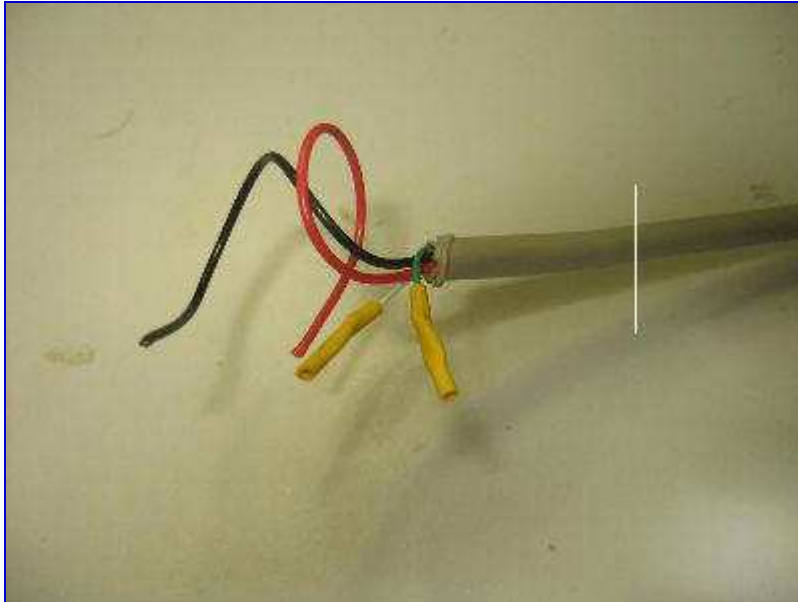
Click USB_cable_end.jpg to enlarge (or click on the image to open in new window)

Prepare the enclosure by drilling holes, sawing and filing until you end up like this:

Click enclosure.jpg to enlarge (or click on the image to open in new window)

Before we start solering the wires we make a knot in the cable coming from the Wii and the USB connector cable. You can also use a tie-wrap, kit, or anyting else to make a pull reliever.

• Start with the cable coming from the Wiimote. Solder the yellow and green wires to the momentary switch. For the last time (hopefully) insert the batteries in the Wii and test the momentary switch. After testing, do not forget to remove the batteries!
• Take the USB cable. Solder the red + (plus) wire on one pin of the on/off switch. Solder a red wire from the other pin of the on/off switch to the pc board on a copper lane of pin 3 of the voltage regulator.
• Solder the USB cable's black - (minus) wire to a ground copper lane (where the minuses of the capacitors are connetced, for example).
• Meticulously inspect the copper side of the printed circuit board for solder spikes and short circuits between the copper lanes. Remove them with a sharp knife, screwdriver, pin, etcetera.
•   Put the switch to its 'off' position, Connect the USB cable to the USB entrance of the PC. Set the switch to 'ON'. The LED should light up.
If not, switch off and check everything. If the LED lights up and you have a multimeter, check the output voltage. It shoudl be 2,85 volts.
• Connect the Wiimote's black - (minus) wire to the copper lane of the - of the capacitors.
• Connect the Wiimote's red + (plus) wire to the copper lane of pin 2 of the voltage regulator.
• For the last time, inspect the copper side of the printed circuit board for solder spikes and short circuits between the copper lanes.
• Piece it all together. With us it looks like:

Click USB_powering_ready.jpg to enlarge (or click on the image to open in new window)

- If necessary, put some kit on the LED and the USB- and Wii wires. Close the cover and put some rubber bands around it.
- Test 'everything' possible before attaching the four screws of the enclosure.
- Enjoy!

In the next section we will treat powering the Wii via an AC to DC adaptor.

7.2.2. Powering the Wii via an AC adapter

Maybe its an idea to first read the previous section. Almost certainly it will convince yoiu that powering the Wii via a AC to DC converter is a piece of cake. In fact the only thing you hav eto do is replace the USB cable for an AC to DC adapter. Hoewver, to play everything on the safe side, here are our guidelines:

- Find an AC to DC power adapter. AC means Alternating Current. The power adapter you find will have an input of 110 to 230 volt AC. It will convert this to DC.
- DC means Direct Current; what batteries supply. The Adapter you find must have a DC power of 3 to 6 Volt. We strongly usuggest you not to use an AC adaptor that gives more than 6 Volt DC. The power regulator is specified to function up to 7 volts, but we want to stay on the safe side. So find a AC to DC adaptor that gives between 3 and 6 Volt.
- Out of the adaptor comes a cable, consisting of 2 wires: the + and the -. It's up to you to find out what the + and the - is. Here are some methods.
    - Find a multimeter to determine + and -
    - Find a resistor of about 200 Ohm. Connect the one wire of the resistor to the + of the LED. Connect the - of the LED and the other wire of the resistor to the power adaptors wires. If the LED ligths up, the + of the LED corresponds to the + of the wire.
    If the LED does not light up, reverse polarity and yoiu have found the + and the minus of the wires of the AC to DC adaptor. Mark them by putting a knot in the + wire.
- Return to the USB setup and connect your knotted wire to the + on the prinbted circuit board.
- Connect the - likewise.
- Proceed as in the USB setup, i.e. test, test, and test again.

In the next section we will consider alternatives to powering tyhe Wii.

7.2.3. Powering alternatives

There are many alternatives to powering the Wii remotely. Here are a few we have found out so far:

- Do not open the Wii cover and solder the battery wires where the batteries are located. Make a hole in the

- Do not open the Wii cover and solder the battery wires where the batteries are located. Make a hole in the battery cover.
- Instead of an AC adapter or USB power supply, buy an enclosure for the sync and power switch in which you can put rechargeable batteries and buy a battery loader.
- This might also be a solution: on http://www.amazon.com/Power-Adapter-Battery-Eliminator-Camcorder/dp/B000XQTH28 you can see:

AC_adapter_battery_eliminator.jpg

An AC power adapter that fits in the battery compartment. Could be a good solution. The picture shows a 110 volt power connection. We use 230 volt. Does it exist?

Sony DK-2AA DC Coupler cable for € 17,95

battery_eliminator_coupler_cable.jpg

- Is it possible to power the Wii via the connector at the rear end?
- ....
- ......

(top)

8. In the classroom

8. In the classroom

We pieced togehter some wood as a beamer stand and fitted it in one of the ceiling panes. Please bear in mind that we are still in the prototyping stage. Below is a picture of the Wii mount on the ceiling. A hole of 5 x 20 mm. was drilled in the battery cover.

PICTURE NOT YET READY

[wii hole in battery cover]

Click classroom_wii_hole.jpg to enlarge (or click on the image to open in new window)

Two hooks and two 5 mm. coach bolts and butterfly nuts are used to precisely fix the wiimote. In this way calibaation is seldom necessary.
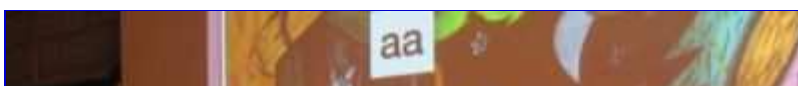

Click classroom_wii_mounted.jpg to enlarge (or click on the image to open in new window)

Click classroom_ceiling_2.jpg to enlarge (or click on the image to open in new window)

We have replaced the blackboard with a formica surface of 200 x 130 centimeters. 2 speakers are not yet mounted. Enlarge the picture to see the beeamer mounting.

Click classroom_whiteboard_1.jpg to enlarge (or click on the image to open in new window)

Pupils have no problem using the infrared pen (chalk version) to write their first words.

Click classroom_pc+wiipower.jpg to enlarge (or click on the image to open in new window)

(top)

9. Useful links

Below are links that relate to the technical hard- and software aspects of the digital whiteboard with the Wii remote controller. Educational applications are handled in the chapter Educational software for the Wii remote digital whiteboard with IR LED pen HOWTO. Some links overlap. This chapter is heavily under constructoi#$n.

Uwe Schmidt created a Mac version in Java of Johnny Lee's original WiimoteWhiteboard program. It can be found at http://www.uweschmidt.org/wiimote-whiteboard. Comes with source and good license.

Linux electronic whiteboard - This is an effort to make a GNU/Linux port of Johnny Chung Lee's program http://code.google.com/p/linux-whiteboard/

Boon Jin Cho's "Wiimote Smooth Board". Also based on Johnny's software with lots of really useful features -- for educational purposes-- and a good manual. See http://www.boonjin.com. You need the WiimoteSmoothboard0.2.rar version and not the 0.2.2. Use 7-Zip from http://www.7-zip.org/ to unrar. No source (yet?) and unclear license.

WiimoteSmoothboard0.2.rar version and not the 0.2.2. Use 7-Zip from http://www.7-zip.org/ to unrar. No source (yet?) and unclear license.

A teacher compares the Wiimote interactive whiteboard versus a commercial interactive whiteboard: hhttp://www.youtube.com/watch?v=BSDxc2kFjms&feature=related

Jason Smith Wiimote Presenter uses the wiimote the other way around as described in this howto. The IR source is fixed, the Wii moves. Fascinating possibilities for presentations, see Wiimote Presenter was initially created to use the Wiimote with PowerPoint presentations. Needs .NET framework 3.5. Good manual.

The Wiimote Forum http://www.wiimoteproject.com/ offer valuable information, ideas, solutions for problems and help.

The WiiYourself! project. Libraries (?) to create software. This link is not for immediate use. http://wiiyourself.gl.tter.org/

Description of Wii remote (very technical): http://wiibrew.org/w/index.php?title=Wiimote

Wiimote/Drivers: http://www.wiili.org/index.php/Wiimote_driver

WiiMoteStackTester by Pat Glynn: http://www.hl2world.com/bbs/1-vt47004.html?start=0. Pat writes: "Stack tester. Wiimote connect testing program. If the program does not close on you and you see the raw wiimote values your wiimote will work". Not yet tested (ds).

Bluetooth Guide: http://www.jonsguides.com/bluetooth/index.html. A very good guide to get Bluetooth working.

List of Working Bluetooth Devices: > http://wiibrew.org/w/index.php?title=List_of_Working_Bluetooth_Devices

<div align="right">(top)</div>

10. Discussion

Using the Wii in conjunction with a beamer and whiteboard in a classroom asks for a real simple setup. Most teachers are good in teaching, not in computing, configuring software or complicated setup procedures. Here are some ideas, wishes, uncertainties and stuff for discussion.

- Smooth Board ported to Linux. Boon Jin Goh has written excellent software that makes a lot of teachrs' wishes come true, but it's only for Windows. Who does the port to Linux Ubunto 8.4?
- And Mac?
- How do we get the most simple procedure to start the whiteboard for a teacher? What she shoud do is: Start PC and after x seconds she has a working whiteboard.
  Boon Jin Goh's Smooth Board eliminates the calibration procedure in a fixed environment. But you still have to press the red button to sync?
- Is it possible to power the Wii via the rear connector? Answer: probably not.
- Is it possible to do syncing remotely. This point and the previous one would make it superfluous to open the Wii. Could solutions be found at http://www.arduino.cc? And how? Please help!
- Wiimote whiteboard programs should be Open Source programs under good licenses.
- VGA splitter. Lets you use a beamer and a monitor, which seems useful in a classroom. Costs about € 12.
- When the Wii is mouted to the ceiling, the LEDS are invisible. Can the built in speaker give a signal when the Wii is connected?
- An extension cable exists! That could facilitate a connectinon to the Wii without soldering in it.
- To-find-out-list:
      What are pin 2 and 5 on the Wii?
    - How to power the Wii externally?
    - Which contact on the red sync switch on the Wii has to be connected to start synchronisation? Probably solved.
      Who wants to make an Arduino board or some other microprocessor (open hardware!) to automate

- Who wants to make an Arduino board or some other microprocessor (open hardware!) to automate processes?
- Does a cheap IR camera + processor stuff etc. exist that makes the Wii remote superfluous?

~~The Nunchuk connector at the rear has 6 pins according to:: http://www.wiili.org/index.php/Wiimote/Extension_Controllers/Nunchuk#Connector~~

~~1 - green - data~~
~~2 - nothing~~
~~3 - red - 3.3+v~~
~~4 - yellow - clock~~
~~5 - nothing~~
~~6 - white - ground~~

~~Pin 2 and 5 seem not used by the Nunchuck. Can we use them for synchronisation? And pin 3 and 6 for powering? This would eliminate any soldering in the Wii~~
New details available, see below.

The pinouts of the Wii from http://wiire.org/Wii/protocols/wiimote_bus from which we quote:
[quoe]

The Wiimote accessory bus is a 6 pin data connection that can connect various attachments (the Nunchuk, or the Classic Controller) to the Wiimote and use it to relay control data back to the Wii console. Although there are 6 pins, so far it appears one is completely unused, and one is included but it's use has not yet been determined.

Wiimote Bus Pins (6-pin proprietary connector on Wiimote)   [edit]

Looking into Wiimote:

```
 _____
|    135   |
|    246   |
|___---___|
```
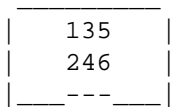
- 1 (Red wire) - +3V
- 2 (Yellow wire) - Clk
- 3 (Red wire) - Attachment detection?
- 4 (No wire) - Unknown (unconnected at Nunchuk connector)
- 5 (Green wire) - Data
- 6 (White wire) - GND

[end quote]

Who can help finding a connector to the bus? Is it possible to power the Wii via the bus? Is it possible to sync via the bus? No need to open the Wii anymore! Any ideas welcome.
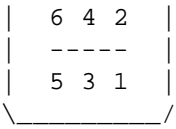
Another link on the Wii Remote pinouts: http://www.hardwarebook.info/Wiimote_Expansion_Port from which we quote:

Available at the Wiimote, remote control of Nintendo Wii.

For connection of Classic or Nunchuck controller to Wiimote.

Pinout

```
|~~_____~~|
|          |
|  6 4 2   |
```

```
|  6 4 2  |
|  -----  |
|  5 3 1  |
_____/
```
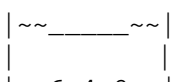
From the Wiimote side

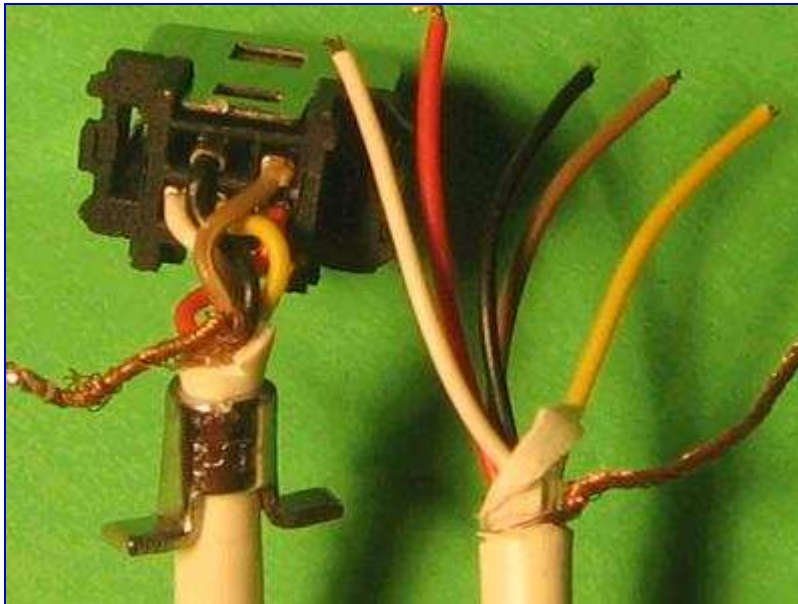| Pin	Cable color	Description
1	Red	3.3V
2	Green	SDA. I²C Serial Data
3	Red	Connected to 3.3V inside attachment connector
4	-	Not connected.
5	Yellow	SCL. I²C Serial Clock. (400 kHz)
6	White	Ground

Notes

- I²C slave address is 0x52.
- Gameboy Advance Link Cable connector is similar.

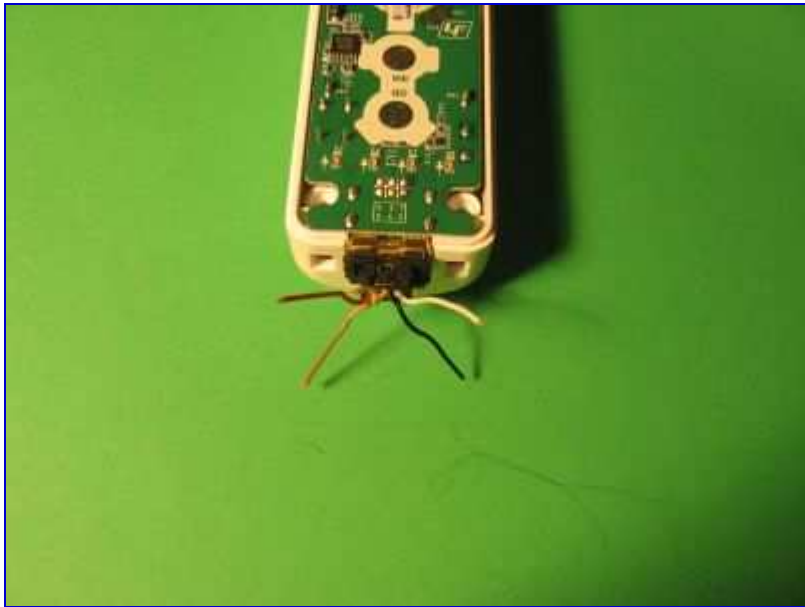# Source

- Wii Linux: Wiimote

[end quote]

My humble opinion on the pinouts:

wii_connector_1.jpg

Click wii_connector_2.jpg to enlarge (or click on the image to open in new window)

Everything mentioned on wire colours seems not valid and can change with differing cable manufacturers. Everyone seems to agrees on this pinout:

```
----___----
|  6 4 2  |
|  -----  |
|  5 3 1  |
----------- metal SHIELD
```

This is what you see looking at the rear of the Wii. For us the following seems important:

- Shield: Is connected to the - 3 Volt of the battery clip
- Pin 4: Not connected. Is this really true? Then we can connect a wire from the sync switch (use the 2 pins near the '2' button on the cover. The 2 pins are connected) to pin 4 on the connector.
- Pin 1: + 3 Volt. Heck!@! This is only the case when the sync button is pressed. When the Wii is off, no power on this pin.
- Pin 6: GND. Ground. When the sync button is pressed, 3 volt is found between pin 1 and 6.

Does this mean that the connector is useless for classroom use because the connector cannot be used to power the wii in a simple way? That is:, supply 3 volt via the connector and use pin 4 to synchronise by connecting it to SHIELD. More info needed.

Maybe we need a combination of:

- Power the Wii via an AC adaptor. Put the PC board where the batteries are located.
- Open the Wii and connect pin 4 to sync (untested!!). Use pin 4 and shield for the remote syncing...
- by means of:
  - extension cable and switch
  - Transistor and UV light?
  - 433 MHz transmitter and receiver. Conrqd part no. 13 04 28-12 seems a viable option. Must be tested.
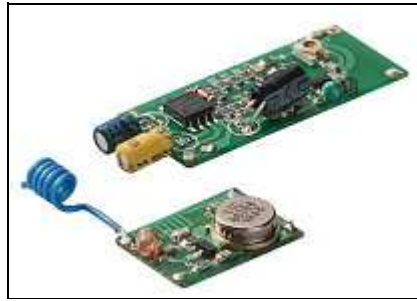
433MHz_tx_rx_conrad.jpg

And the wiring diagram 130428-sp-01-en-Sender_Empfaenger_Modul_Set_433MHz.pdf
What extra components are needed to start synchronisation?

- Other *simple* ideas are most welcome!

(top)

11. Concluding remarks

Every time new details are found, new solutions are tried (success and failures!) and in the classroom new ideas emerge. This project iss surely is a project under construction.
Comments, hints and critique are most welcome as well as improvements on the language. We're not native speakers and had to use a Dutch Windows XP version.

Technical support and advice is also most welcome to help schools in obtaining a cheap digital interactive whiteboard. Thank you for your attention.

(top)

12. References

[1]
> There are many DIY projects to build a beamer. Google is your friend. Main advantages from a schools perspective: Low- or no noise in your classroom, cheap and easy lamp replacement, not attractive to thieves, ideal to demonstrate a lot of optical and technical priciples.

[2]
> Picture taken from: http://www.pondelectronics.com/. '+' and '-' added by author.

[3]
> Picture taken from http://www.riccibitti.com/, a great site for simple DIY electronic PC projects. Even the making of a printed circuit board is clearly described. Worth a detour.

(top)

13. Changelog

- 2008-07-27: Publication on Wiimoteprojects.com.
- 2008-08-09: Classroom pictures added, text improved.
- 2008-08-15: Nunchuk extension cable found.
- 2008-08-30: Procedure to open and close Wii now a piece of cake.
- 2008-09-02. Pinouts are known.
- 2008-09-03. Nunchuk stuff striked out. Pressure sensitive pen design ready.
- 2008-09-07 Changes in section 9 an 10. Pinout pictures added.
- 2008-09-15 433 MHz transmistter and receiver added.
- 2008-09-18 How to read this howto adapted.
- 2008-10-29 Idea for cable between Wii and PCboard added.

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Introduction

Author: Dirk Schouten <schoutdi at knoware dot nl>
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