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The documentation of a blinking project ...

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Contents

This script is available as html- and pdf- version, as well as the source file as OpenOffice document in the net under http://littlelights.de

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http://www.gnu.org/copyleft/copyleft.html

1.0 project description

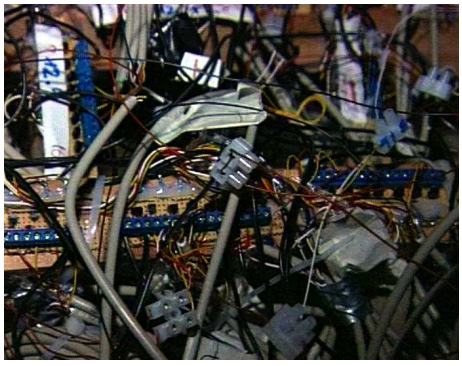
1.1 early history

From the 12th of September 2001 to the 23th of February 2002 there was the worldwide biggest light-installation Blinkenlights [1] at the Alexanderplatz in Berlin. Blinkenlights was developed and installed by the Chaos Computer Club [2] for the 20th anniversary of the CCC. The installation was located in the Haus des Lehrers [3] [house of the teacher], which was unused and should be reconstructed soon. Blinkenlights consisted of 8 floors with 18 windows each. Behind every window there was a single lamp on a self-made tripod. Each lamp was connected to the power source via a relay. If the relay switched on, the window pane became bright. In order to achieve the appropriate self-illuminated effect they have painted all windows with white color. The lamps had a capacity of 150W only.

Haus des Lehrers in the middle of the 80's

Thus they created a monochrome matrix with 8x18 pixels. Every single lamp was controled by a computer. At night animations where shown at the house. Further it was possible to play Pong via mobile phone or to show your own loveletter at the house. The software from Blinkenlights was published under GPL as FreeSoftware and is free available for everyone. Videos, software to create and play the Blinkenlights animations, dokumentations and reports you can find at the Blinkenlights websites [1].

Blinkenpaint Screenshot



BlinkenLights cable salad

Blinkenlights was everywhere in the media and people were quite taken, even there were generally no good news about blocks of flats at this time. Around 1000 movies (approximately 300 of them loveletters) were created in the 5 months and 23 days running time of Blinkenlights and "Die Toten Hosen" [4] made their video to "Was zählt" in the house. Blinkenlights caused quite a stir concerning the creative dealing with technology.

[1] http://www.blinkenlights.de
[2] http://www.ccc.de
[3] http://www.bcc-berlin.de
[4] http://www.dth.de

1.2 realization

LittleLights is a miniature reconstruction of Blinkenlights and is 100% compatible with the original Blinkenlights movies. It can also be used as Winamp analyzer, news & status-information-display etc. More information about these features can be found in chapter 3.

Blinkenlights at Alexanderplatz

The basic hardware itself is identical with BlinkenLEDs [1], where 144 low-current LEDs are connected to 18 8bit shift-registers, which are controlled by a Standard PC with centronics-port. The LittleLights-hardware is controlled in exactly the same way, except that instead of LEDs an amplifier-PCB and 144 incandescent lamps are used. The miniature-house is 115cm high and the hardware (PC, PCBs, power-supply..) is fixed inside. Ventilation has to be used because even the lamps alone dissipate about 150W when about 100 are on. The house has got interfaces for keyboard, mouse, screen, audio and LAN.

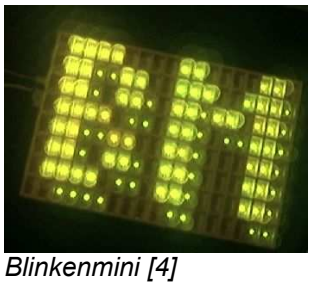
LittleLights under Construction

BlinkenLEDs [1]

The Blinken LED Player is used to play the movies. This player is a simple OpenSource-version of the original Blinkellights-software and was modified so that it works with the shift-registers. The software will be introduced and detailly descripted in the same named section. Blinkenlights was not only inspiration for LittleLights, after the installation at the Alexanderplatz further projects emerged, like Bushfire [2], Arcade [3], BlinkenMini [4] and other blinking things [5].

Arcade [3]

Bushfire [2]



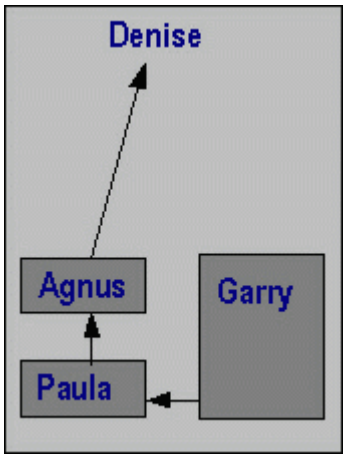
Blinkenmini [4]

[1] http://www.blinkenleds.de
[2] http://www.blinkenlights.de/bushfire.de.html
[3] http://www.blinkenlights.de/arcade
[4] http://www.haecksen.org/~sphaera/blinkenmini
[5] http://www.blinkenlights.de/links.en.html

2.0 hardware

2.1 general assembly

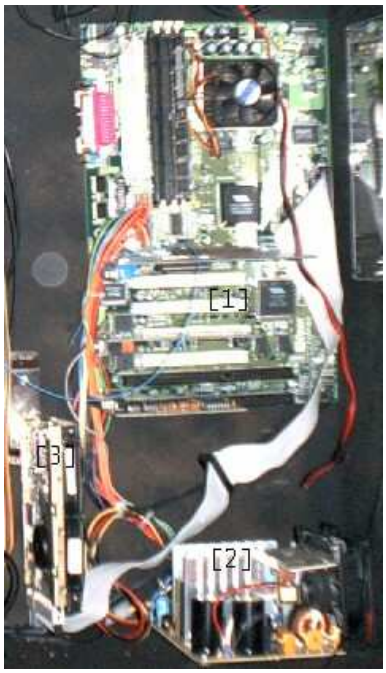
The hardware in general consists of 4 main parts: a standard PC [Garry], the shiftregister PCB [Paula], the amplifying PBC [Agnus] with its 144 field-effect-transistors and the house [Denise] itself. The 144 lamps, power-supply, Garry, Paula and Agnus are all inside Denise.

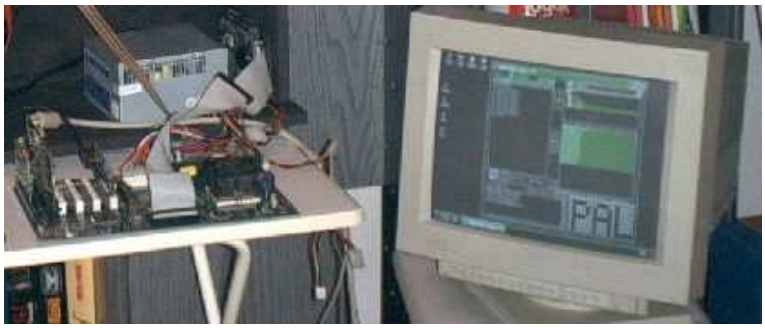


The names of these 4 parts where used for the customchips of the Amiga.

Garry prepares the data for the shift-registers and sends them to Paula over the centronics-port. Paula uses this data to generate 144 signals for the lamps and sends them on to Agnus. Here the 5V signals are amplified to about 33 - 36V (dep. on Transformer wiring) which now switch the corresponding lamps inside Denise.

2.2 Garry



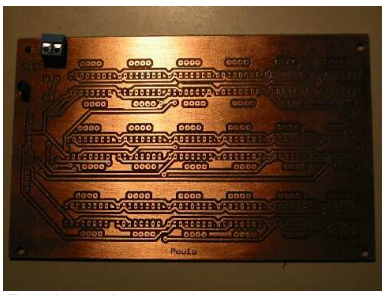


test phase

The left picture shows Garry inside Denise:
[1] Mainboard
[2] Power-supply
[3] Harddisc

Garry is a standard PC, that was fixed inside the house without any type of case. The PC prepares the signals from the software, so that they can be used by the shift-registers on Paula. The 450MHz processor is underclocked and is only running at 400 Mhz to keep power-dissipation low.

2.3 Paula



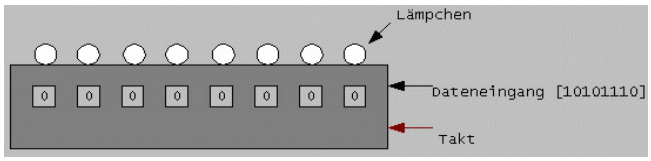
Paula unbestückt

Controlling 144 lamps isn't easy, especially when those lamps need to be logic '0' or '1' at all times. This means, that we would need 144 outputs from the PC, but since the centronics-port can only offer a fraction of those outputs, we had to find a different solution. The original Blinkenlights control PC used three expansion cards with 48 outputs each. This would have been an elegant, but also expensive way of solving the problem, so we decided to use the 18 8bit shift-registers like BlinkenLEDs.

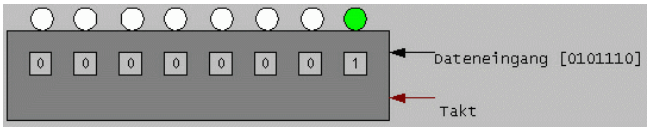
How does a shiftregister work? [a try of a comprehensive explanation]

The most important part of the shift-registers is a D-flip-flop (memory cell, 1bit memory) that memorizes the state of the output. If the shift-register is „clocked“, the data from the serial input is shifted forward to the next flip-flop. The output of the flip-flop is the parallel output, but there is also a serial output so that a few registers can be cascaded as done here.

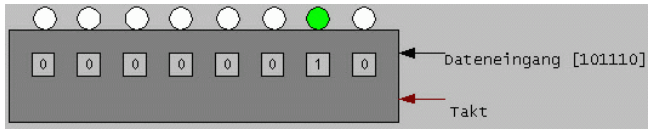
Each shift-register is a small integrated circuit, that in our case has 16 pins, of which 8 are the connections for the parallel outputs to the FETs and lamps. The functions of the remaining pins are listed on page 6. The best way to explain the shift-register is with help of an example, so lets assume the outputs are connected to lamps or LEDs.



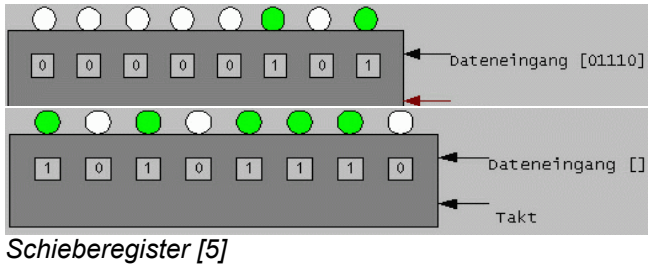
Schieberegister [1]



Schieberegister [2]



Schieberegister [3]

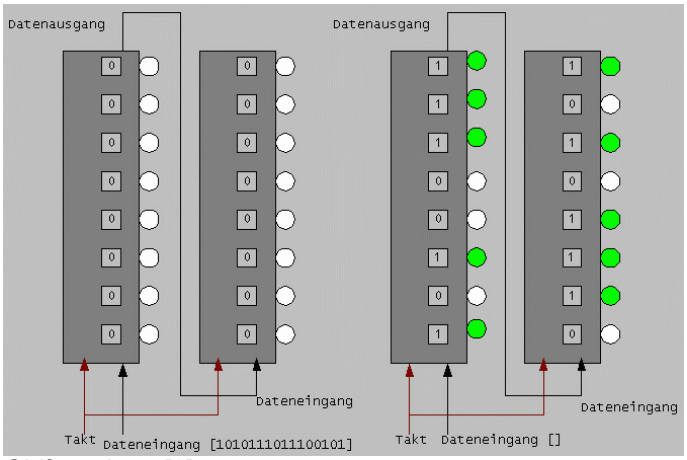


Schieberegister [5]

In this example all memorys contain logic zero (0V) [1]. A bit-combination is applied to the input and then a short impulse to the clock-input. After that has happend, the first bit of the combination has been shifted into the first cell [2] and therefore the first parallel output ~> the first lamp is on. If the register is „clocked“ again the second bit moves into the first cell and the first one is moved to the second cell [3]. With the next clock the third bit is moved into the first cell and the ones in the cell are moved on [4]. After the eighth clock all bits are in the cells, and the lamps, corresponding to the bit-combination, are on [5]. In this way the first bit at the input is moved into the first cell an the bits already in the register are moved forward by one cell.

In our case the clock-signal is so fast that the single steps can't be registered by the human eye. Just about as soon as the bit-combination is applied, all the bits would have „fallen“ out of the serial output.

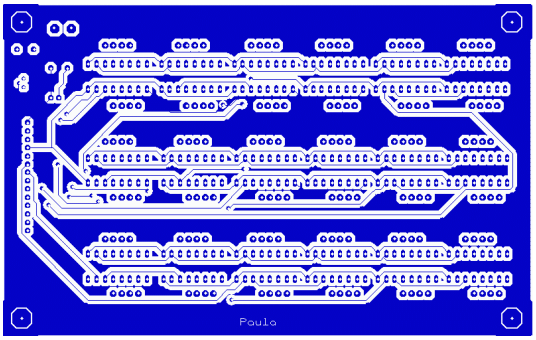
This means, that it is possible to control 8 lamps with one output of the centronics-port. But to control 144 lamps the port would need to have 18 outputs, so we had to use a little trick.



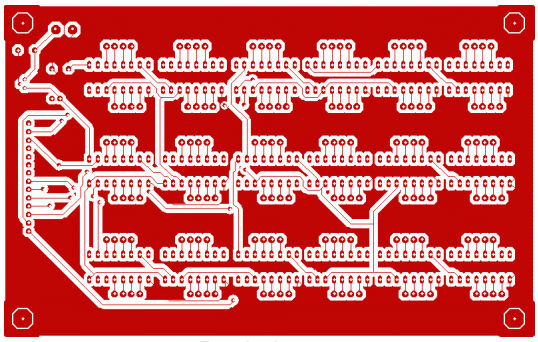
Shift-register [6]

With help of the serial outputs of the shift-registers two or more registers can be cascaded [6]. With this method 16 or more lamps can be controlled and therefore we only need 9 outputs from the centronics-port. The house has 18 columns with each 8 rows, therefore one output controls 2 columns.

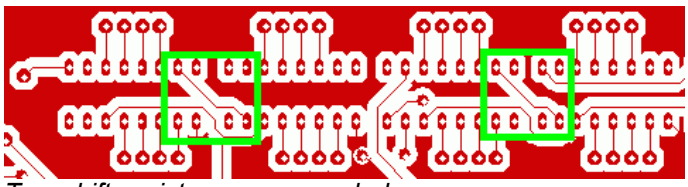
Lets now have a closer look at Paula.



Paula top



Paula bottom

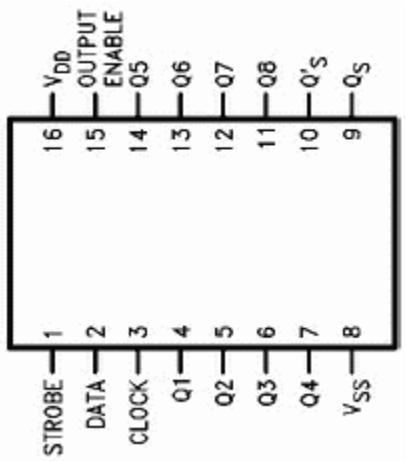


Two shift-registers are cascaded

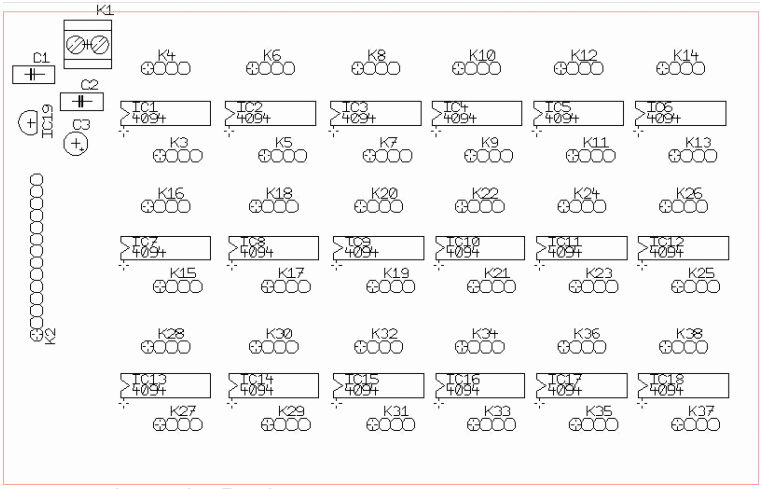
The 18 shift-registers on Paula, cascaded to 9 sets of 2. This can easily be seen from the bottom of the PCB.

The 4094 pinout

Pin 01	Strobe – takes over the transferred bits into the register
Pin 02	Data - Serial Data In
Pin 03	Clock
Pin 04	Q1 - Parallel Output 1
Pin 05	Q2 - Parallel Output 2
Pin 06	Q3 - Parallel Output 3
Pin 07	Q4 - Parallel Output 4
Pin 08	V_{SS} - Ground
Pin 09	Q_S - Serial Data Out
Pin 10	Q'_S - Data Out, pushed by the next negative flank
Pin 11	Q5 - Parallel Output 5
Pin 12	Q6 - Parallel Output 6
Pin 13	Q7 - Parallel Output 7
Pin 14	Q8 - Parallel Output 8
Pin 15	Output Enable - Output Activity Control
Pin 16	V_{DD} - Supply Voltage (5V)



How are the parts on the PCB connected?



construction units Paula

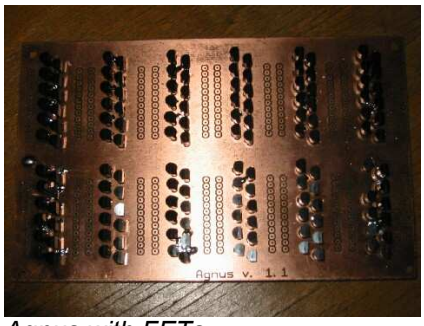
As can be seen on the left picture, IC01 to IC18 are shift-registers. K3 to K38 are groups of 4 pads that are connected to the outputs of the shift-registers, and from these pads the wires continue to Agnus. K2 is a modular connector that connects Paula and Garry with a ribbon cable. The pins V_{SS}, $V_{DD,}$ Clock, Strobe and Output Enable are all connected together.

Modular connector K2

K2	Circuitboard	PrinterPort
01	Ground and to all ICs [Pin 08]	Pin 18 - Pin 25 and connector-shield
02	Clock to all ICs [Pin 03]	Pin 14
03	Output Enable to all ICs [Pin 15]	Pin 17
04	Strobe to all ICs [Pin 01]	Pin 16
05	not connected	
06	Data of IC 15 [pin 02 of each IC]	Pin 09
07	Data of IC 13 -"-	Pin 08
08	Data of IC 11 -"-	Pin 07
09	Data of IC 09 -"-	Pin 06
10	Data of IC 07 -"-	Pin 05
11	Data of IC 05 -"-	Pin 04
12	Data of IC 03 -"-	Pin 03
13	Data of IC 01 -"-	Pin 02
14	Data of IC 17 -"-	Pin 01

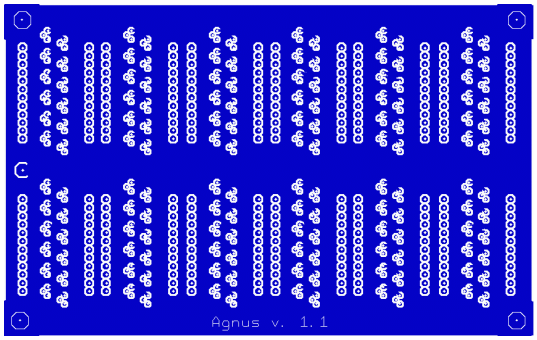
The ICs 1&2, 3&4, and so on are cascaded. This means that pin 10 of the first IC is connected to pin 02 of the second IC etc. The supply-voltage for Paula is connected to K1, here 12V. IC19 is a fixed 5V voltage-regulator (78L05), that is connected to pin 16 of all shift-registers. C1 and C2 are 100nF bipolar capacitors, C3 is a 10µF electrolytic capacitor. These three capacitors stabilise and smooth the supply-voltage of the shift-registers. An overview of all connections that come from Garry, can be found above in "Modular connector K2". Because Paula has quite a few traces, the PCB had to be double-sided, but nevertheless a few wire connections had to be made.

2.4 Agnus

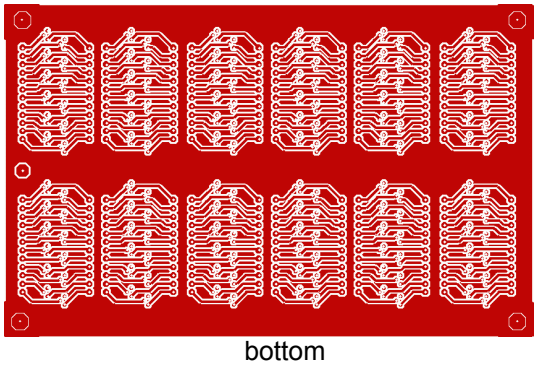


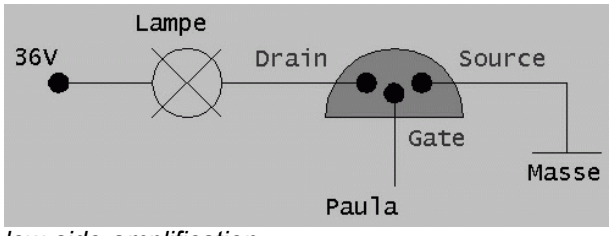
Agnus with FETs

Since 36V incandescent lamps where used for the house it was not possible to connect the lamps directly to the shift-registers. To obtain the higher voltage and current needed, the signals from Paula have to be amplified.



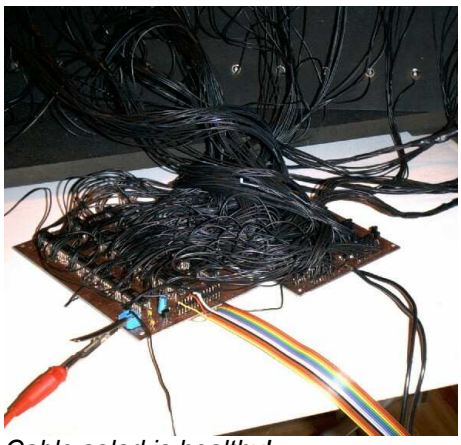
top


bottom



low-side-amplification

As can be seen on the pictures, Agnus is also a double-sided PCB. The 144 N-channel enhancement-mode MOS-FETs are assembled to a low-side-amplification-circuit (left picture). Every lamp has it's own FET. The lamps are directly connected to 36V, and when the FET is switched the other side of the lamp is pulled down to ground ~> then the lamp is on.


Cable salad is healthy!

Here you can see Paula at the front with ribbon cable to Garry, and Agnus with the 144 wires that go directly to the lamps. Nothing should be canged round here.

2.5 Denise

LittleLights in the 19C3 lab

Denise is more or less the case for Paula, Agnus and Garry and consists of **m**edium **d**ensity **f**iber boards , plastic-glas and a lot of screws. We bought 7 boards of **MDF**-wood with 16mm thickness and the following dimensions:
2x 75,0 x 115,0 - front, back wall
2x 20,0 x 113,4 - side walls
1x 75,0 x 28,2 - base plate
1x 75,0 x 20,0 - ceiling plate
1x 71,8 x 113,4 - insertion [lamp-holder]

All boards are still the same size, except for the lampholder, which was shortened at the top and bottom to improve air circulation.

Building the house

The first step was to screw the boards to a box, so that we could see, if everything would fit properly, and to drill the holes for the screws. This was the first time that we noticed, how large our construction would be. Then the box was dismantled again and the positions of the windows where sketched on to the front. Then two holes had to be drilled for each windows so that we could use the jigsaw to „cut“ out the windows. Larger windows where sawn into the back and the top to be able to see the inside of Denise. A large round hole was sawn into the top for the case fan and another into the back for the aluminium plate with the switches and socket. A few leftovers where enough to make four „feet“. When everything was sawn, we started varnishing. Every single unit has to be varnished two or three times, until the colour properly covered. At the end we put clear varnish on the outsides. We still had to drill 144 holes into the lamp-holder, on which we sticked aluminium foil for reflection. The amount of time we spend for all that can be estimated at about a week (five to six hours per day) in a not heated garage in the middle of November. At this point we want to thank Emsa, a company which produces very good thermal coffee pots.

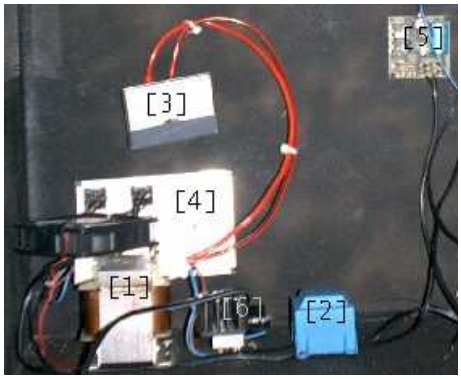
Highlander sawing the windows

ST with Denise

Moraine equiping the reflector

After the work in the garage we could get inside, where it was nice and warm, to do less rough work. First we wired up the reflector, that means the threads of all lamps were connected with each other and then the lamps were screwed into the reflector.

The power-supply



[1] 160VA transformer with fan
[2] 25VA PCB-mount transformer
[3] amperemeter
[4] aluminium panel with switches and mains socket
[5] regulated and adjustable power supply
[6] rectifier with heatsink, behind is the 10.000µF capacitor

Denise is not only the case for Paula, Agnus and Garry, but also the power-source. An aluminium panel with power socket, two power switches and two micro-switches was fixed to the back of Denise. The first power switch connects the two transformers to the mains. The first transformer [24V 160VA] supplys the lamps through a bridge-rectifier [80C35A], a 10.000µF electrolytic capacitor and a amperemeter at around 35VDC. The second transformer is a PCB-mount type [15V 25VA] ,connected to the adjustable power-supply [0V – 15V], supplies Paula, case-fan and the fan for cooling the 160VA transformer. A blue fluorescent lamp was also fixed inside Denise for better illumination, and also draws its current from the adjustable supply. The second power-switch connects Garry to the mains, and the micro-switches are to reset and switch on Garry.

After the cut up Persplex panes were installed behind the window holes, only Paula, Agnus and Garry had to find their place in the case. Then the lamp-holder was built in. In addition a "raster" was put on screws in the lamp-holder. It is used to divide the light from every single lamp, otherwise also the neighbour windows would be shining. To suppress this effect we further put seal tape (actually used to seal doors and windows) between raster and lamp-holder to make the windows as lightproof as possible. Thanks to Jan, Kathes brother, for this great and cheap idea. While the "indoor work" the front wall was painted by Cindy 'Slide' Krause. She painted the original communist marquetries in oil on it, now it looks like the real house of the teacher. The original frieze was made 1964 by Walter Womacka.


At the 19C3: Kathe while trying to seal the windows

After the front has dried Denise could at last be put together completely. This happened, after nearly two months of building and constructing, on December 20 of the year 2002.

3.0 Software

The main task of LittleLights is to run Blinkenlights-movies. A special file-type was designed for Blinkenlights, it is called Blinkenlights-Movie and has the suffix .blm.

A *.blm file consists of a header and the data itself, which decides which lamp is on at which time.

The information in the header is easy to understand (example: Littlelights Intro):

# BlinkenLights Movie 18x8	// file format
# name = LittleLights	// name of the film
# description = LittleLights Intro	// additional description
# creator = Blinkenpaint 2.4	// programm that created the film
# author = ST	// author
# width = 18	// width in pixels
# height = 8	// height in pixels
# loop = no	// repeat
# duration = 27450	// duration in ms

The data is made up of several „pictures“, where a 1 means the lamp is on, and 0 off. The number after the @ defines how many ms the picture should be displayed.

@500	@100	@1000
000000000000000000	000000000000000000	011111111000000000
000000011100000000	000000100100100000	100010100100000000
000000100010000000	000000010101000000	100001111111111100
000000000110000000	000000000111000000	100001111111101110
000000001100000000	000111111111111000	100010100100011100
000000000110000000	000000000111000000	011111111000000100
000000100010000000	000000010101000000	000000000000011010
000000011100000000	000000100100100000	000000000000101001

The films can be created by hand or with the help of Blinkenpaint, that allows one to create films „easy & quick“. More informations about the *.blm format and Blinkenpaint itself can be found on the Blinkenlights webpages. Apart from Blinkenpaint there are lots of other useful tools for download.

Since the Littlelights hardware is not identical with the Blinkenlights hardware, modified software is required, and already there is a relatively large amount available.

Blinkenpaint

Important!

Before the software described below can be installed, the port I/O drivers have to be installed. These allow direct control of the ports under Windows 95, 98, Me, 2000, and XP.

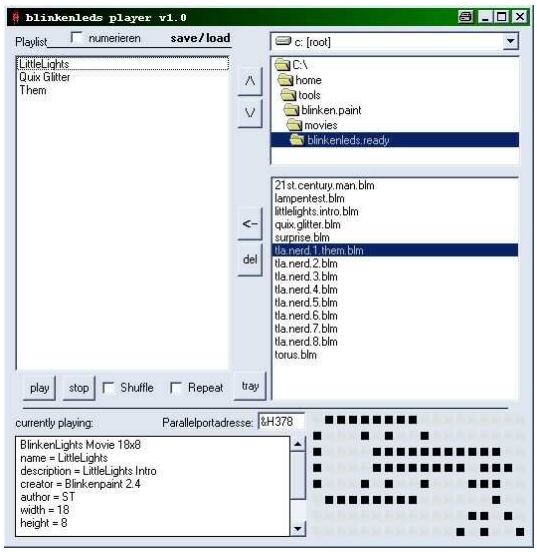
The drivers are available for free download from Scientific Software Tools at http://www.driverlinx.com .

In some cases it may be necessary to install the Visual Basic Runtimes 6. These can be found on CDs that come with magazines and in the internet. A search engine should find some results.

To be able to use the functions of the Winamp player, version 2.x is required. The 3.x versions are presently not supported. The latest Winamp 2 version is 2.91 and can be downloaded at http://classic.winamp.com , where also the necessary VBLink Plugin can be found.

The software will only be quickly introduced and not described in detail as most functions are relatively easy to use and more ore less self-explaining. Should there nevertheless be any problems try http://www.jalcdsforum.de . Most problems have already been discussed thouroghly. The searchfunction can also be quite helpful.

3.1 Blinkenleds Player *von Hoomair*



The Blinkenleds Player is the first software that was written for the 18-register-versions of Blinkenlights. It can play *.blm files, and therefore also send the data to the centronics-port. The player also has a playlist with repeat and random functions, and also a preview. The centronics-port adress can also be configured so that the program is compatible with I/O expansion cards. No problems where encountered when run under Windows 98SE and Windows 2000 SP3.

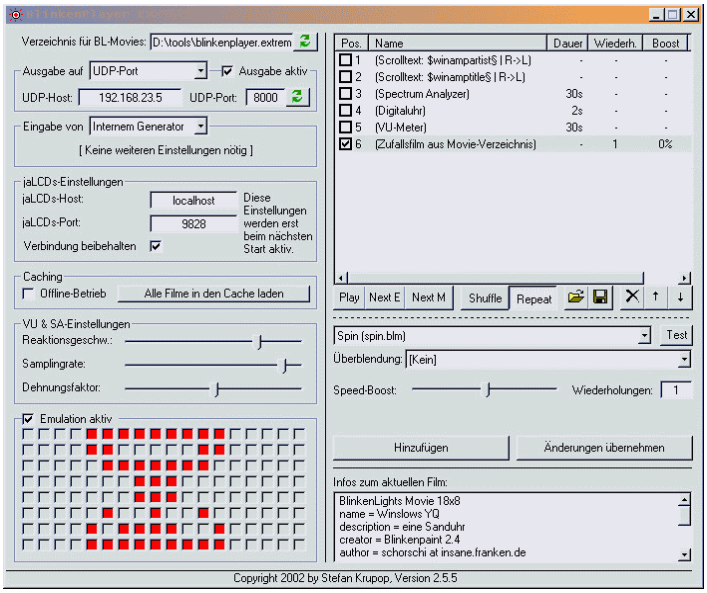
Download: http://www.blinkenleds.de

3.2 BlinkenPlayer Exxtreme *von Stefan Krupop*

The BPE offers the functions of the Blinkenleds Player and a few more e.g. sending the signals over ethernet with UDP. LittleLights uses this feature. BPE is now the only player that is run on Garry, it watches the UDP port and sends arriving signals to the lamps. Scrolltext, binary-, digital-clock, jaLCDs variables, Winamp Spectrum Analyzer and VU-meter can also be displayed. The films can be played at different speeds, different playlists can be saved and so on.
The BPE has an exxtreme amount of functions and through the posibility to display jaLCDs

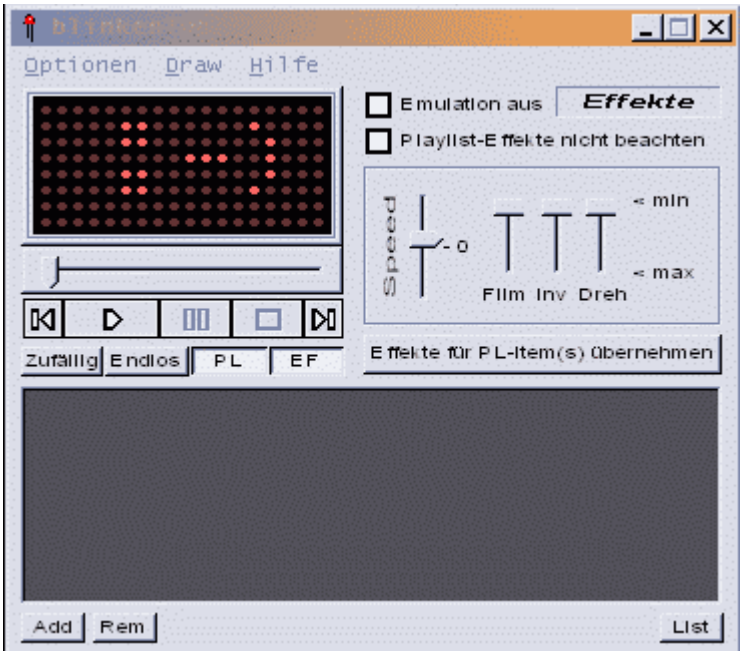
variables more or less infinite. BPE 2.5.5 was no problem under Windows 98SE and Win 2000 SP3.

Download: http://www.jalcdsforum.de



3.3 BlinkenTool *von Manuel Flöther*

Except for UDP, BlinkenTool supports nearly all the functions of the BPE in a more compact form. Furthermore a drawing-function is implementaded and the possibility to make and invert movies. The digital clock can be loaded with different font types. This tool was running under Win 98Se and 2000 SP3 stable and without any problems, too.



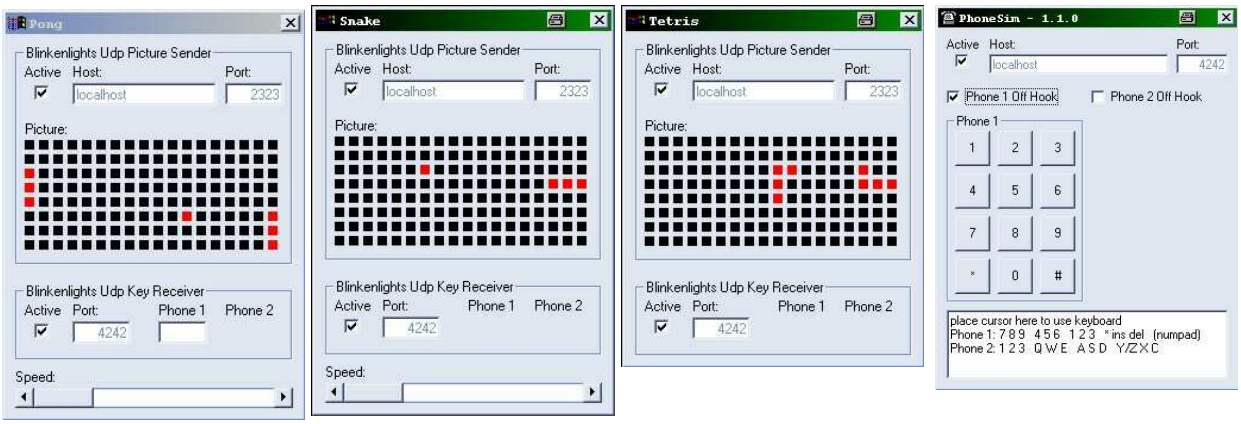
Download: http://www.jalcdsforum.de

To all tools I can say that they are running without any problems and are very intuitive to use. Who worked on this topic a little bit, will cope with the tools easily.

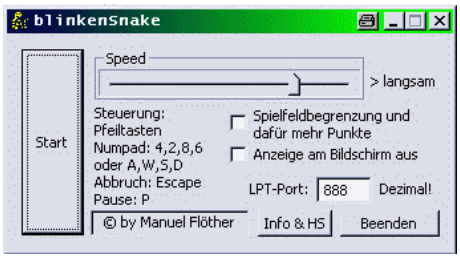
3.4 Pong, Snake and Tetris from *1stein*

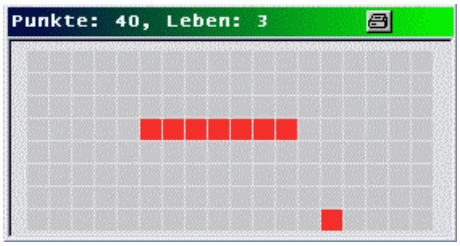
What are blinking devices without games? Pong, Snake and Tetris from 1stein have full UDP support and can be controlled via PhoneSim from a PC inside the network.

Download: http://blinkenmini.schuermans.info/stuff/BlinkenLeds



Furthermore exists **BlinkenSnake from *Manuel Flöther***





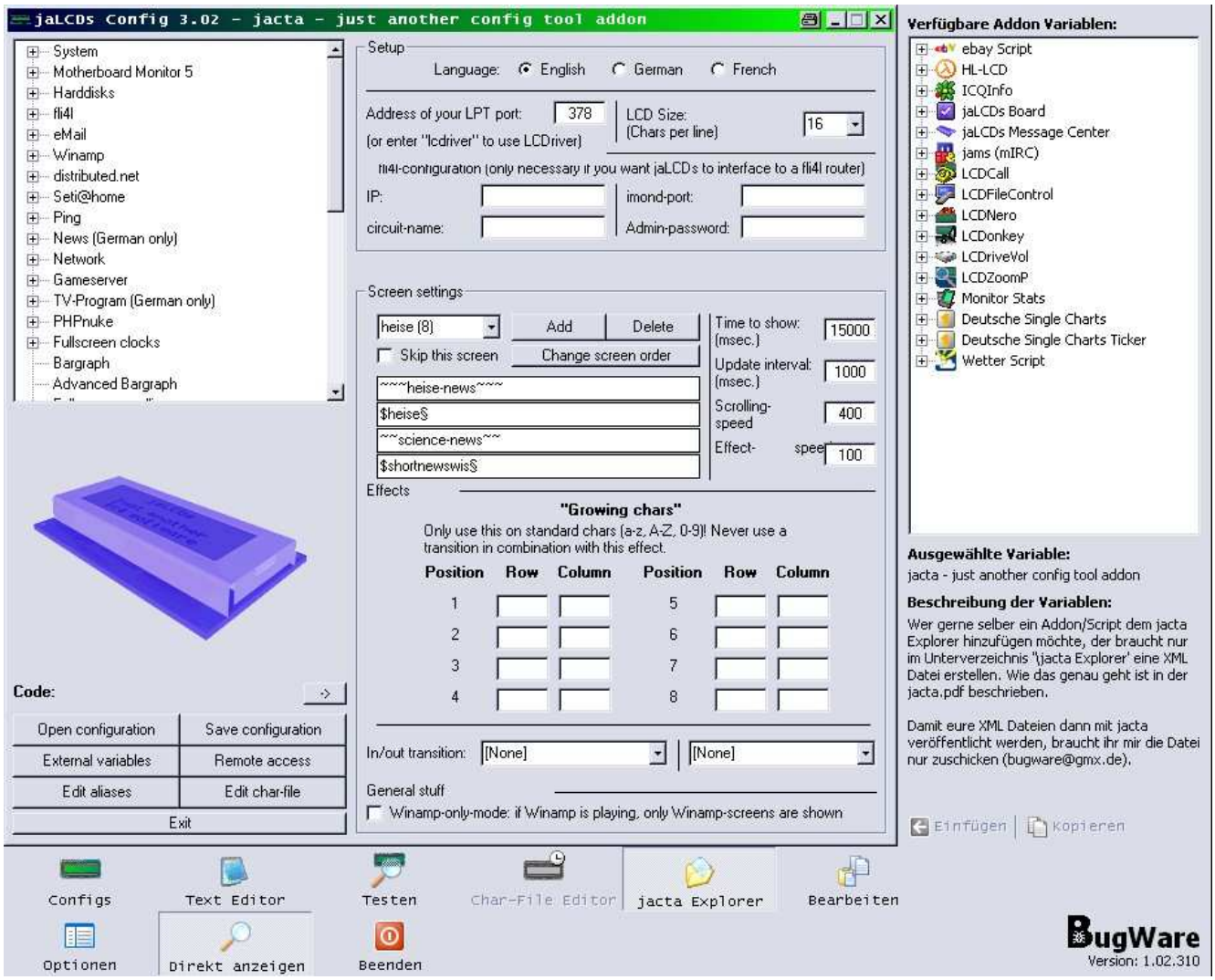
BlinkenSnake is a Snake conversion without network-support. It can be played immediately without any tool.

Download: http://www.jalcdsforum.de

3.5 jaLCDs from *Hoomair & all the others jaLCDs programmers*

Just Another Liquid Cristal Display Software is basically an LCD Software. A huge amount of variable can be generated by jaLCDs and read with UDP-capable players. So its possible to diplay news, weather, status-reports of all kinds. JaLCDs (v.3.1 instance 1) was running under Win 2000 SP3 without problems.

Download, infos, FAQ, forum: http://www.jalcds.de



jacta [configuration-tool] from jaLCDs

4.0 List of materials

Description	Qty.	Source	Order number	PU	TP
Garry					
Mainboard: AOpen AX59Pro	1	Concept Werbeagentur			30,00
Processor: AMD K6 II [450MHz]	1	Concept Werbeagentur			10,00
CPU-cooler: Sockel 7 Maximus	1	Concept Werbeagentur			5,00
RAM: 256MB Infinion CL 2	1	MLC Baustoffberatung			40,00
Graphicscard: Elsa Victory Erazor/LT-8 SD [AGP]	1	Highlander			10,00
Network adaptor:10/100 MBit Ethernet Adapter [RTL8139]	1	Reichelt	LANKARTE PSI-100	5,00	5,00
Patchcable: 15m CAT5	1	Reichelt	PATCHKABEL15 GR	6,60	6,60
Harddisc: SeagateST3660A [IDE 545,5MB] + IDE-Cable	1	ST			5,00
Powersupply: Enlight Corporation 230W ATX	1	Highlander			10,00
Cablefree mouse + keyboard: Tevion	1	Aldi		19,95	19,95
Monitor: 15" Daewoo CMC-1502B	1	ST			20,00
Monitor extension lead: 3m	1	ST			9,00
Paula					
14-pole IC-socket pins (16-pole not available)	21	Farnell	177849	2,92	61,32
MOS 4094 - 8bit shift-register	18	Reichelt	0	0,28	5,04
Epoxydplatine 1,5mm, both sided Cu 35µm 100x160mm	1	Reichelt	BEL 160x100-2	2,40	2,40
Voltage-regulator L78S05	1	Conrad	179345-62	0,82	0,82
Bipolar Capacitor 100nF	2	Reichelt	X7R-2,5 100n	0,12	0,24
Electrolytic capacitor 10µF	1	Reichelt	0	0,04	0,04
Double screwterminal for PCB 5,08mm	1	Reichelt	0	0,13	0,13
Stiftleiste (36 pieces, 14 are needed)	1	Reichelt	STIFTL. 36G	0,17	0,17
SUB-D plug 25-pole	1	Reichelt	D-SUB ST 25	0,14	0,14
Ribbon-cable 14x1,27 mm, 1m	1	Reichelt	AWG 28-14F	0,87	0
SUB-D top metallic	1	Reichelt	KAPPE 25M	0	0
Agnus					
Epoxydplatine 1,5mm, both sided Cu 35µm 100x160mm	1	Reichelt	BEL 160x100-2	2,40	2,40
Field-effect-transistor n-channel V_{DSS} 60V I_D 500mA	150	Reichelt	0	0	0
Denise					
Wood boards MDF 16mm [1]	7	DIY		20,40	39,00
Colored varnish, matt black	7	DIY		4,60	32,20
Spray transparent	1	DIY		4,60	4,60
Spray wooden glaze	1	DIY		5,60	5,60
Persplex 250x500x2 mm Polystrol	4	DIY		7,12	7,12
Case fan Papst	1	ST			15,00
Tights (for women)	1	Lidl		0,99	0,99
Fluorescent lamp [AIV] 12V blue 38cm	1	Media Markt		14,99	14,99
Aluminiumfoil	1	Minimal		0,99	0,99
Greaseproof paper	1	Minimal		0,99	0,99

Description	Qty.	Source	Order number	PU	TP
Roof slats 5x30mm 2,40m	7	DIY		2,49	17,43
Seal tape 10m	2	DIY		4,99	9,98
Wood glue Ponal Express	1	DIY		3,49	3,49
Nails, screws	n	DIY			10,00
Transformer 24V 160VA	1	Highlander			35,00
Case fan Sunon (for Trafo)	1	ST			5,00
Bridge rectifier 80C35A (35A 80V)	1	Reichelt	B80C35A	1,45	1,45
Heatsink for 80C35A (Socket 7 52x52x35mm)	1	ST			1,50
Elko 10mF 40V Axial	1	Reichelt	AX 10.000/40	3,55	3,55
Printrafo 15V 25VA ERA	1	Reichelt	EI 60/25,5 115	8,70	8,70
Construction kit, adjustable power supply 0-15V	1	Reichelt	B-020 NT	14,00	14,00
Aluminium plate 10 x 10mm	1	Baumarkt		3,00	3,00
Rocker switch 2-pole 10(4)A/250V~ green	2	Reichelt	WIPPE 1805.7109	2,55	5,10
Installation device with socket fuse	1	Reichelt	KES 1SI	1,55	1,55
Fuse 5x20mm medium sluggish 4A	0	Reichelt	MTR. 4,0A	0,07	0,70
Miniature pushbutton	2	Reichelt	T 250A GN	0,12	0,24
Analog installation measuring instrument 0-10A	1	ST			10,00
Small lamps 24-36V 50mA E10	150	Reichelt	L 3459	0,26	39,00
Device connecting pipe 1,8m;3x0,75	1	Reichelt	NKSK 200 SW	1,65	1,65
Isol. Copper wire 1-adrig;1x0,14mm;10m	18	Reichelt	LITZE SW	0,59	10,62
3x1,5mm copper lead 1m	1	ST			0,50
Solder 1,0mm 100gr. Sn60 Pb38 Cu2 F-SW 26	1	Reichelt	0,00	1,35	1,35
Desolder wick 8mmx1,7m	1	Reichelt	ENTLÖTLITZE 00	1,00	1,00
Womacka-Frieze					
Oil paint and varnish					5,00
Sum:					**484,24**

If Highlander or ST is named as the source of parts, these where provided by the respective owner himself. The prices are estimated (more or less eBay-prices). When the sources are Concept Werbeagentur or MLC Baustoffberatung, the parts where sponsored by these companies.

Reichelt – http://www.reichelt.de
Farnell - http://www.farnell.de
Conrad - http://www.conrad.de

PU - price per unit in Euro
TP - total price in Euro

[1] wood boards dimensions

2x 75,0 x 115,0 - front, back wall
2x 20,0 x 113,4 - side walls
1x 75,0 x 28,2 - base plate
1x 75,0 x 20,0 - ceiling plate
1x 71,8 x 113,4 - insertion [lamp-holder]

Conclusion

When I was standing at the Alex while attending the 18C3, watching the house of the teacher and thinking: "I need that, too." I could never believe, that this wish will come true. As in progress of my studies we should make a project, I knew what I want. But wherefrom taking people, with whom I can carry it thruogh to the end? That I can lean back now here in my NOC and next to me a very cool toy is blinking, is not only due to me, also the effort of a lot of people. At this point I want to say thanks to all of them.

Moraine and Highlander,
who, after listening to my enthusiastic description of my project, spontaneously said: "Yes sure, you can count at us." But their were not aware of what they got involved into.

Slide,
who sat down just before christmas to paint the frieze, even she was ill. She didn't even was annoyed by my rush.

Herr von Kirn [FH - Isny],
who said: "Blinking house? Well, okay." and placed vakuum-typesetter, foam-corroder, drills and tools for our disposal.

Benno Gerum [FH - Isny],
who gave his okay for LittleLights as a project for our studies and made sure that we get the first constructions units very fast.

Hubert & Resi,
for the complete garage, where we could built the house at any time.

Hoomair & all the other jaLCDs programmers,
for Blinkenleds and jaLCDs.

Stefan Krupop,
for the BlinkenPlayer Exxtreme and online-debugging in ICQ.

1stein,
for Pong, Tetris, Snake, the clock and bugreports.

Manuel Flöther,
for the BlinkenTool and BlinkenSnake.

Blinkenleds-Forum,
for the help and all the useful information that can be found there.

Jan,
for the genious idea with the sealing-tape.

Blinkenlightscrew,
for Blinkenlights and the motivation to build LittleLights.

Tim Pritlove,
for the HiRes-scan of the original Fries and the Congress-support.

Concept Werbeagentur [Cottbus],
for the sponsored PC.

MLC Baustoffberatung [Cottbus],
for den sponsored Memory.

My Mom and my Grandma,
which sponsored the (still expensive) rest.

Kathe,
for correcting the docu, presentation and webpages.

At the end I want to say thanx to all people I've forgotten and who helped, that LittleLights is blinking now. As well as the people who had to tolerate my moods while the building-phase (depending on how the house worked). Remains to wish everyone a lot of fun with the device. Have fun with the device ;-) !