

Goals of the project	
How a relay works	
Logic	
Relay logic	4-Bit-Relay-Adder
Half/Full Adder	How does a Relay-CPU calculate?
Signed integers	
Photos	Maximilian Noppel
Facts	
Lessons learned	
Demo	July 18, 2020
W/het/e mout?	, , , , ,



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- Preproject for EuroTwo
- Explainable binary calculation
- Design aspects
 - (indirect) LED indicators for everything and illumination in general
 - boardcolor
 - haptics, feeling



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- Mechanical aspects
 - connectors, mounting, screws
 - powersupply
 - switches
- Electronical aspects
 - logic family



Inspiration

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Source: https://www.youtube.com/watch?v=x3pyi9P4N08



Mein Ergebnis

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- Working with 0,1
- Logic gates
 - AND, OR, XOR, NOT, NOR, NAND
- Combining to building blocks
 - Half/Full Adder, Registers, Counters, Multiplexer, Decoder, ...





Logic



AND

А	В	Output
0	0	0
0	1	0
1	0	0
1	1	1



NAND

А	В	Output
0	0	1
0	1	1
1	0	1
1	1	0





Α	В	Output
0	0	0
0	1	1
1	0	1
1	1	1

NOR

В Output

0 0 0

А 0 0 1

0 1 0



v	0	
^	U	R

Α	В	Output
0	0	0
0	1	1
1	0	1
1	1	0



XNOR

А	В	Output
0	0	1
0	1	0
1	0	0
1	1	1

Source: https://instrumentationtools.com/logic-gates/



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Relay logic

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Adder	0	1
Signed	floating	±5\/
integers	nouting	
Photos	GND	+5V
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Half Adder

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A XI Sum					
А	В	Carry	Sum	CarrySum	
0	0	0	0	00	
0	1	0	1	01	
0	0	0	1	01	
1	1	1	0	10	



Full Adder

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А	В	C	Carry	Sum	CarrySum
0	0	0	0	0	00
0	0	1	0	1	01
0	1	0	0	1	01
0	1	1	1	0	10
1	0	0	0	1	01
1	0	1	1	0	10
1	1	0	1	0	10
1	1	1	1	1	11



1 Bit Full Adder in Relays

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4 Bit Adder





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Unsigned integers





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Half/Full Adder	0010 2	
Signed integers	1101 one's complement of 2	invert
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Half/Full Adder	0010	2	
Signed	1101	one's complement of 2	invert
integers	1110	-2 (two's complement of 2)	+1
Photos		(**************************************	1.
Facts			
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Half/Full Adder	0010	2	
Signed	1101	one's complement of 2	invert
integers	1110	-2 (two's complement of 2)	+1
Photos	0001	one's complement of -2	invert
Facts	I	·	



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Half/Full Adder	0010	2
Signed	1101	one's complement of 2
integers	1110	-2 (two's complement of 2)
Photos	0001	one's complement of -2
Facts	0010	2 (two's complement of -2)
Lessons	0010	
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invert

+1*invert* +1

Demo



Signed integers





Solution to use signed integers

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Signed	Add controlled inverter
Photos	• Switch for C_0

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4 Bit Adder





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The finished Adder

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The backboard

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The lights

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The wires

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Facts!

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proj	ec	t		

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What's next?

Current:

■ 90mA per Relay

 $\blacksquare \sim 2.6 {\rm A}$

Frequency:

- 10ms per Relay
- Targetfrequency of EuroTwo: 2 4Hz

Price:

Don't ask!



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- Backlight illumination is not worth it
- (Data)wires on the front would help explaining how is works!
- LED Backillumination: Use Cu on the front!
- Use connectors for the switches



Lessons learned

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- What's next?

- Use DPDT Relay for MUX,DEC and Registers
- Better labels for signed calculation! Or now labels at all.
- White PCBs are better!
- Do not solder every single wire \rightarrow screws!



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EuroTwo

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- Most of the PCB are planned and layouted. Just need to order.
- ControlUnit (CU) left
- Datawires on the front, connected via screws
- Powersupply on the back, through mountings
- No backlight illumination
- PWR LED on the back of each PCB
- Size: 5x5 = 25 PCBs



EuroTwo

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EuroTwo





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hotos	https://wiki.vspace.one/lib/exe/fetch.php?media=
acts	20180918_template_presentation.zip
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Licence

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What's next?

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