

Alarm Clock Controlled Automatic Curtain Opener

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Outline

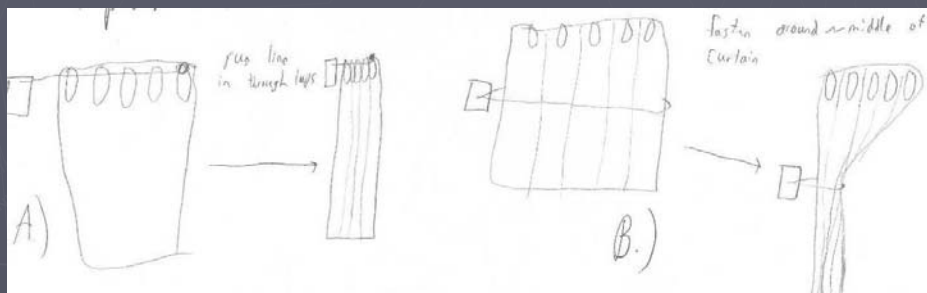
- ▶ Introduction
- ▶ System Design
- ▶ Hardware Design
- ▶ Testing
- ▶ Project Management
- ▶ Lessons Learned
- ▶ Demo
- ▶ Questions

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Introduction

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Conceptual Sketch



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Criteria

- ▶ Alarm Clock Controlled
- ▶ Automatic shut off when open/closed
- ▶ Manual Control
- ▶ Quiet
- ▶ Off the shelf components
- ▶ Easy to install
- ▶ Under \$100

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Methodology

- ▶ 1. Research Phase
- ▶ 2. Design Phase
- ▶ 3. Build/Troubleshoot Phase

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Market Analysis

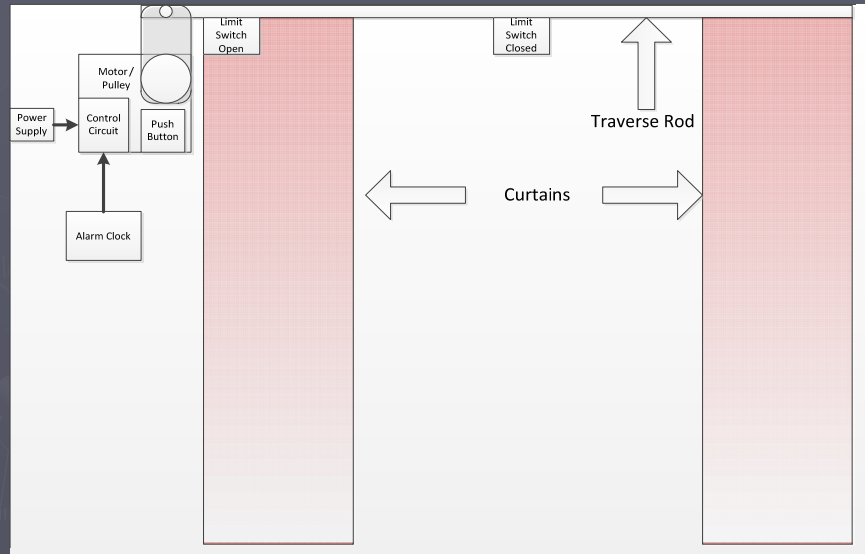
- Makita - \$759.95
- SunSeeker - \$317.00
- My goal – under \$100.00

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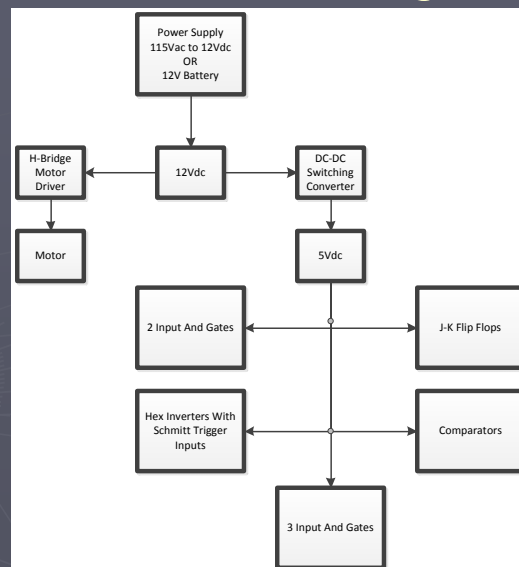
System Design

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High Level Block Diagram

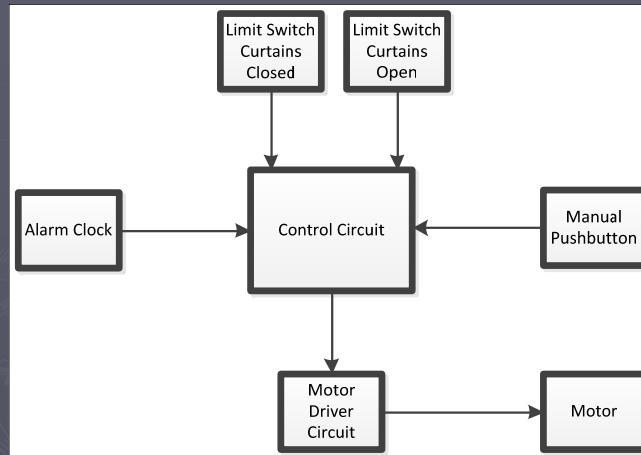


Power Block Diagram



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Signal Flow Block Diagram



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Controller Decision Matrix

Microcontroller		Digital Logic IC's	
Pros	Cons	Pros	Cons
Logic changes done in code	Hard to troubleshoot externally	Easy to troubleshoot Externally	Propagation time could limit
Small form	Higher Cost	Low Cost	Add IC's to make some changes
Fast (relatively)	Development Time	No programming required	Must re-wire to change logic
	Need Programmer	Less development time	

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JK Flip Flop State Table

State	2Q	2!Q	1Q	1!Q	Description	Motor Action
State 0	0	1	0	1	Curtains Closed	Off
State 1	0	1	1	0	Open Curtains	On - Open
State 2	1	0	0	1	Curtains Open	Off
State 3	1	0	1	0	Close Curtains	On - Close

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Black Box Design

Inputs

Outputs

Pushbutton

Motor Forward

Limit Switch – Curtains Open

Motor Reverse

Limit Switch – Curtains Closed

System Status 2⁰ Bit (LSB)

Alarm Clock

System Status 2¹ Bit (MSB)

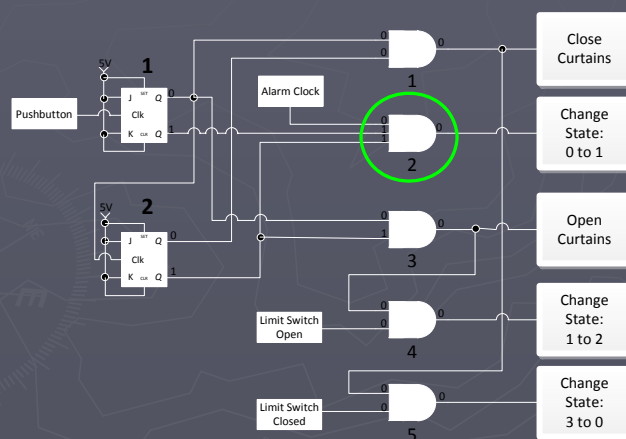
Control Circuit
&
Motor Driver

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Hardware Design

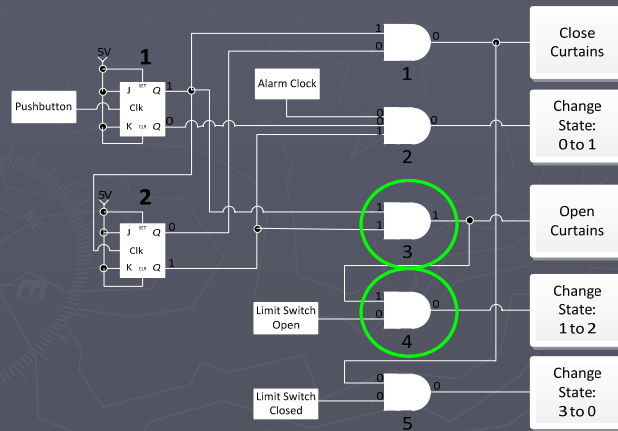
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State 0: Curtains Closed



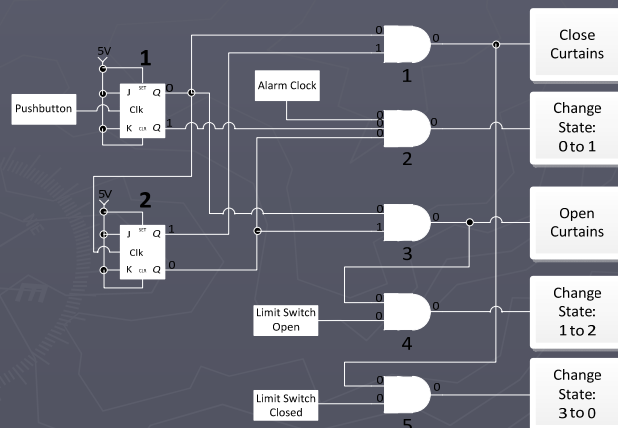
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State 1: Open Curtains

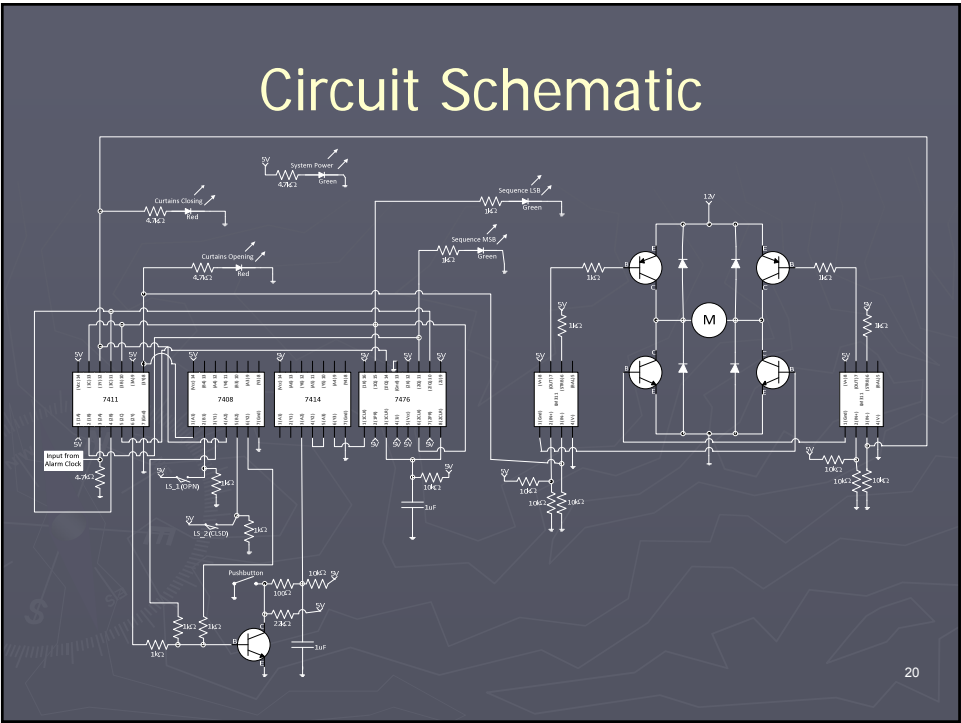


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State 2: Curtains Opened



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Mechanical Design

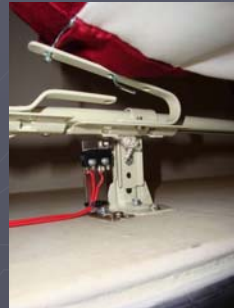


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Testing

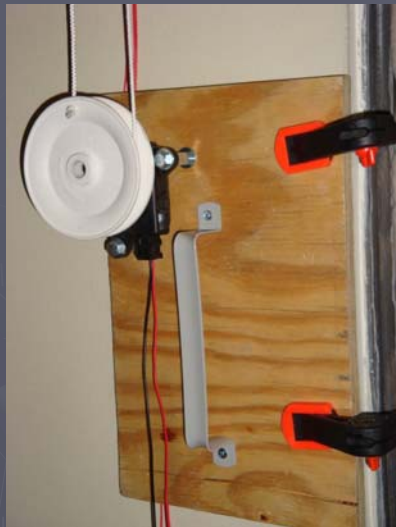
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Test Setup



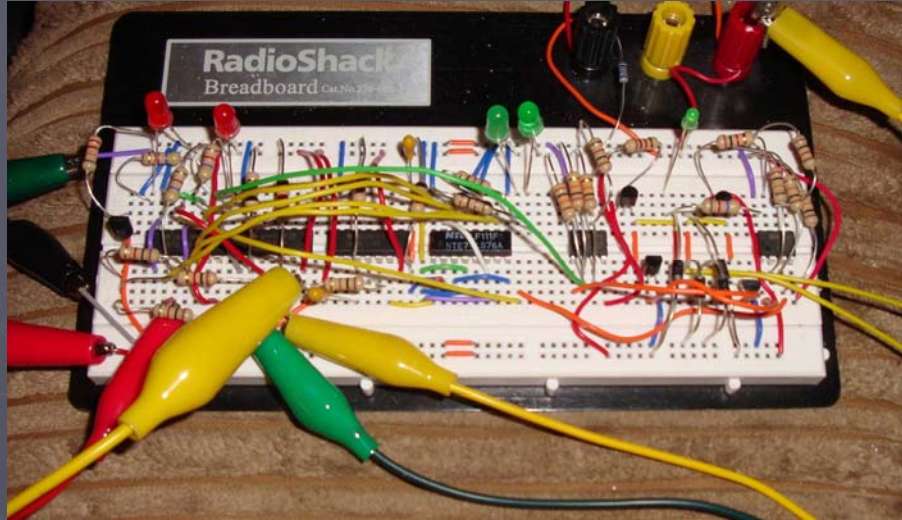
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Test Setup (Cont'd)



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Test Setup (Cont'd)



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Open/Close Time (seconds)

	Trial 1	Trial 2	Trial 3	Trial 4
Open	46.1	46.3	46.2	46.0
Close	45.9	46.2	46.1	46.1

System Current Draw

System State	Opening	Open	Closing	Closed
Continuous Current Draw	58mA	20mA	62mA	17mA
Peak Current Draw	82mA	-	102mA	-

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Project Management

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Gantt Chart

ID	Task Name	Start	Finish	Duration	Jan 2012				Feb 2012				Mar 2012				Apr 2012			
					1/8	1/15	1/22	1/29	2/5	2/12	2/19	2/26	3/4	3/11	3/18	3/25	4/1	4/8	4/15	4/22
1	Research	1/9/2012	2/10/2012	25d																
2	Electrical Design	2/10/2012	3/30/2012	36d																
3	Mechanical Design	3/1/2012	4/6/2012	27d																
4	Build	4/2/2012	4/13/2012	10d																
5	Testing/Debugging	4/9/2012	4/20/2012	10d																
6	Final Report	4/9/2012	4/23/2012	11d																
7	Presentation	4/16/2012	4/27/2012	10d																

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Parts List

Quantity	Part	Purchased From	Their Part #	Price Each	Subtotal
1	7411 3-Input AND Gates	Mouser	595-SN74LS11N	\$0.66	\$0.66
1	7408 2-Input AND Gates	Mouser	595-SN74LS08N	\$0.54	\$0.54
1	7414 Inverter with Schmitt Trigger Inputs	Mouser	595-SN74LS14N	\$0.54	\$0.54
1	7476 J-K Flip Flop	Mouser	526-NTE74LS76A	\$4.52	\$4.52
2	LM311 Comparator	Mouser	511-LM311N	\$0.45	\$0.90
4	1N4001 Diode	Mouser	512-1N4001	\$0.08	\$0.32
3	Green LEDs	Radio Shack	276-1622	\$0.16	\$0.48
2	Red LEDs	Radio Shack	276-1622	\$0.16	\$0.32
1	22kOhm Resistor	Radio Shack	271-0306	\$0.07	\$0.07
8	10kOhm Resistor	Radio Shack	271-0306	\$0.07	\$0.56
3	4.7kOhm Resistor	Radio Shack	271-0306	\$0.07	\$0.21
11	1kOhm Resistor	Radio Shack	271-0306	\$0.07	\$0.77
1	100Ohm Resistor	Radio Shack	271-0306	\$0.07	\$0.07
2	1uF Capacitor	Radio Shack	271-0306	\$1.89	\$3.78
3	2N3904 NPN Transistor	Radio Shack	276-1617	\$0.20	\$0.60
2	2N3906 PNP Transistor	Radio Shack	276-1604	\$0.20	\$0.40
1	Fuse Holder	Radio Shack	270-1281	\$2.99	\$2.99
1	5A Fuse	Radio Shack	270-1071	\$0.55	\$0.55
2	Limit Switch (NO)	Radio Shack	275-0017	\$3.19	\$6.38
1	Momentary Pushbutton (NO)	Radio Shack	275-1556	\$3.19	\$3.19
1	Gear Motor	All Electronics	DCM-276	\$9.00	\$9.00
1	Pulley	Lowe's	349259	\$3.48	\$3.48
1	Alarm Clock	Walmart	590392	\$10.88	\$10.88
1	13.5Vdc 500mA Power Supply	All Electronics	PS-1355	\$6.75	\$6.75
1	Adjustable DC-DC Converter	Sure Electronics	PT-PC031	\$7.99	\$7.99
1	Traverse Curtain Rod	Lowe's	84559	\$13.97	\$13.97
				Total	\$79.92

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Lessons Learned

- ▶ Start early
- ▶ Simple can be deceiving
- ▶ Diagrams are your friend
- ▶ Staying within budget IS possible
- ▶ One step at a time

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Demo

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Questions?

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