The Need:

Passive Solar Design is a great method to help reduce heating loads in the winter. The main strategy is to place a lot of glazing (windows) on the south side of a building to allow for sunlight to enter the space and heat it. This works well in the winter, but it is counterproductive in the summer when the space then gets too hot. Therefore, there is a need to shade the southern exposure during the winter. Furthermore, strong southern sunlight in space can be fantastic, but it can create a lot of glare. The ability to be able to control the amount of light is also important. Finally, glass is not a good insulator. During the night hours the windows release heat to the outdoors and this is not what we want.

Issues to Address:

1) Shade space during the summer
2) Control intense day lighting situations
3) Insulate the space at night.

The Solution:

Louvers and operable windows that can be automatically operate themselves can greatly assist in this solution. The project will use light and temperature sensors placed inside and outside the building. The user will be able to set the indoor temperature and desired amount of light. Then, the louvres and window can adjust to reach this setting. They will not be able to always reach the goals of the user, but they will assist in adjusting the temperature of the space.

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3 Basic States...
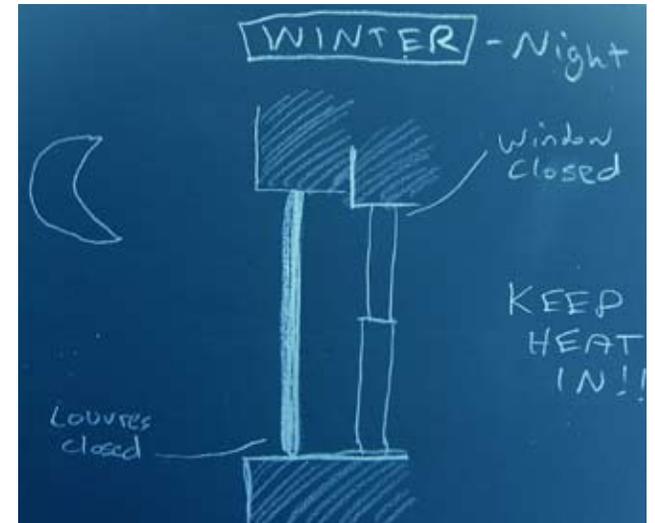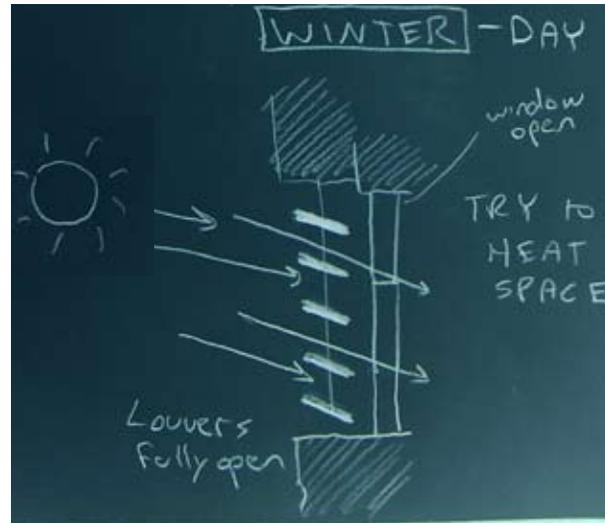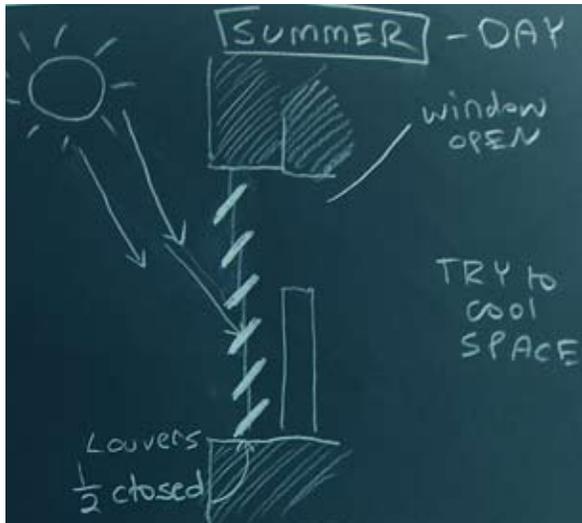
There are 3 basic states that I list here that represent different times of the year and day. It gives a general idea that I expect the system to do. However, I would want it to be able to precisely react to changing levels of light. Therefore, the state of the louvers will need be able to change in small quantities instead of having just 3 positions.

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Layout of Components
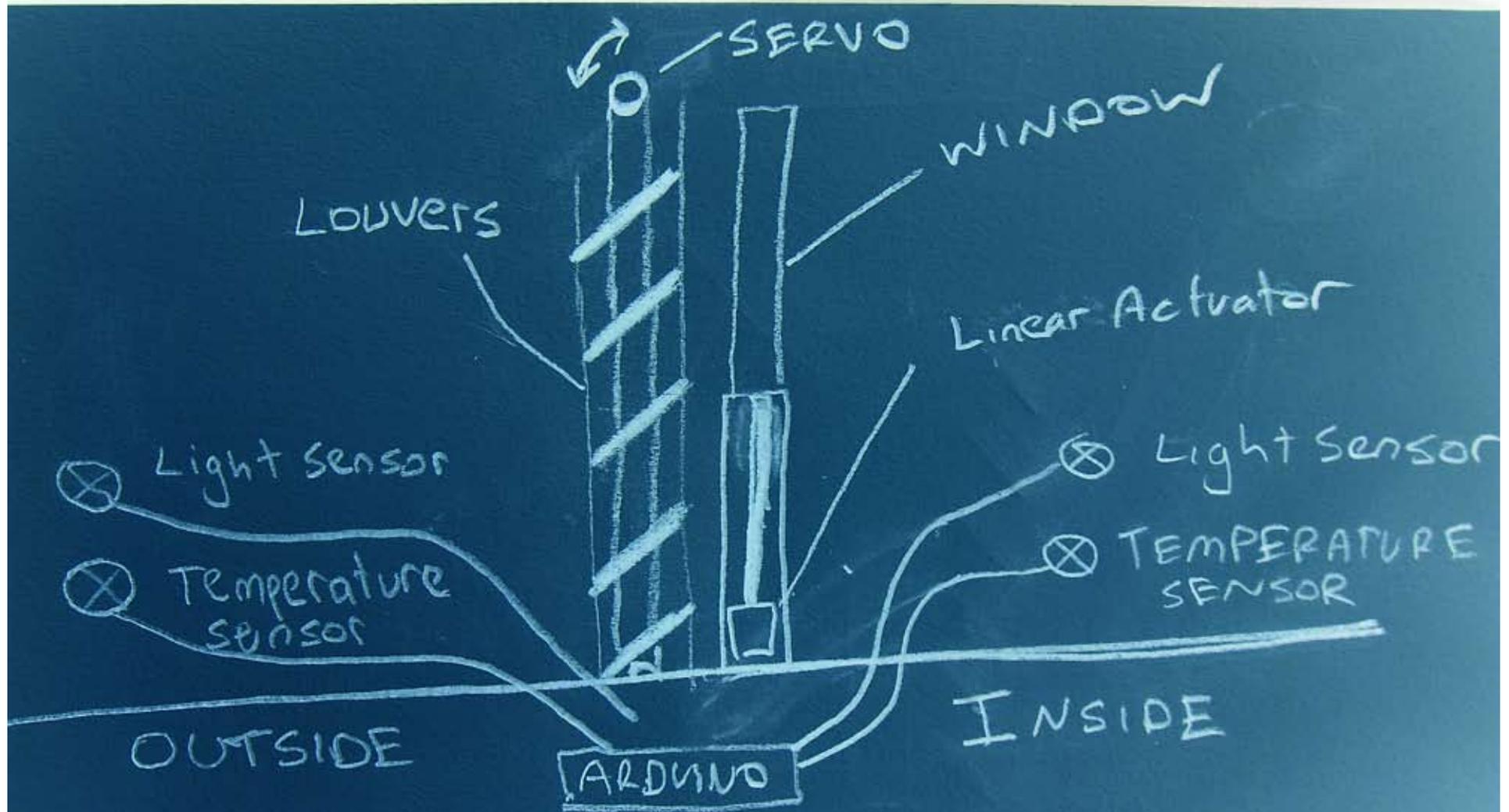
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List of Electronic Parts:

	Have	Need	In Progress
1 Arduino MicroController	X		
1 H-Bridge	X		
2 Servos			X
2 Temperature Sensors	X		
2 Light Sensors/Resistors			
1 Linear Actuator	X		
24V Power Supply	X		

List of Physical Parts:

	Done	Need to Make
5 Plexiglass Louvers		X
Cord of some sort to attach louver gears to servo		X
10 gears for Louvers		X
1 Frame for Louvers		X
1 Mock Window		X

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Code Sketch

int InTemp = 13
int InLight = 12
int OutTemp = 11
int OutLight = 10

The code will use the inputs from the 4 sensors to determine the differences of values between inside and outside to determine what to do with the louvers. It will use a set indoor temp value of 65F, an indoor Lux of 200, and value of 500 Lux outside to tell if the sun is out.

State: Sunny Winter Day
If the temperature inside is below 65F, outdoor temp is below 65F and there is over 500 Lux outside, the louver servo will open them.

State: Dark Winter Day/Night
If the indoor temp is below 65F, outside temp is below 65F, and there is below 500 Lux outside, it will completely close the louvres.

State: Hot/Sunny Summer Day

If the indoor temp is above 65F, the outdoor temp is above 65F, and there is over 500Lux outside, it will put louvers to half open.

Inside Temp Sensor

Inside Light Sensor

Outside Temp Sensor

Outside Light Sensor

+5U
+12U
5U
9U

AREF
AREF
D13
D13
D12
D12
D11
D11/PWM2
D10
D10/PWM1
D9
D9/PWM0
D8
D8
D7
D7
D6
D6
D5
D5
D4
D4
D3
D3
D2
D2
D1
D1/TX
D0
D0/RX

A0 A0
A1 A1
A2 A2
A3 A3
A4 A4
A5 A5

8U 9U

GND
GND1
GND2

GND
GND1
GND2

ARDUINO

GND

S1
2
1

R1
10K

Linear
Actuator

+5U

L293_H-BRIDGE

1	1-2EN	VCC1	16
2	1A	4A	15
3	1Y	4Y	14
4	GND1	GND3	13
5	GND2	GND4	12
6	2Y	3Y	11
7	2A	3A	10
8	VCC2	3-4EN	9

C1
10uF

24V

Servo

Electrical Schematic

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Related Projects:

A patent for a type of Automated Louvres
http://www.wipo.int/pctdb/en/wo.jsp?wo=2007070926&IA=WO2007070926&DISPLAY=DESC

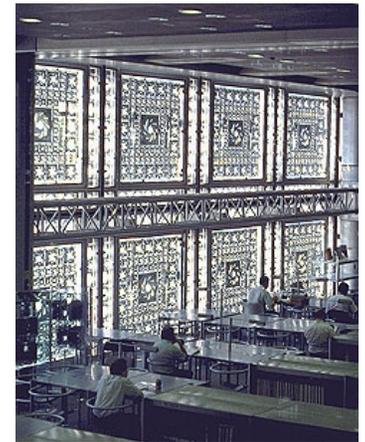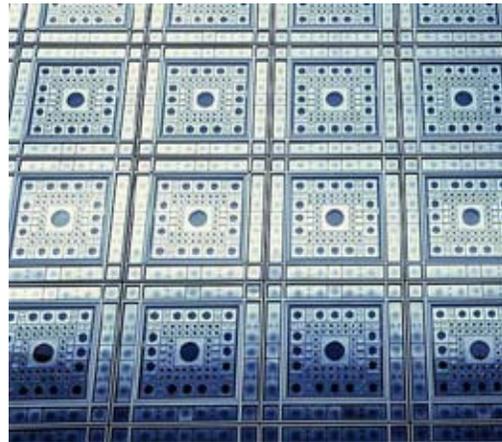**Article on German Solar Decathlon House**
http://blog.wired.com/underwire/2007/11/index.html

Jean Nouvel: L'Institut du Monde Arabe
http://www.greatbuildings.com/buildings/L_Institut_du_Monde_Arabe.html
http://www.galinsky.com/buildings/ima/

Automatic Louvers currently on the Market
http://www.automatedcontrolservices.co.uk/site/products/louvred.html

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State Diagram of Louver System

This is the state diagram for the louver portion of the project. It will be used to control the indoor lighting conditions by opening and closing the louvres. The goal of the project is to be able to control amount of daylight that enters a space and to keep the indoor lighting at the value that the user defines. Its ideal state is to always have 'correct light'. Whenever the level of sunlight changes, the louvers automatically start moving to compensate.
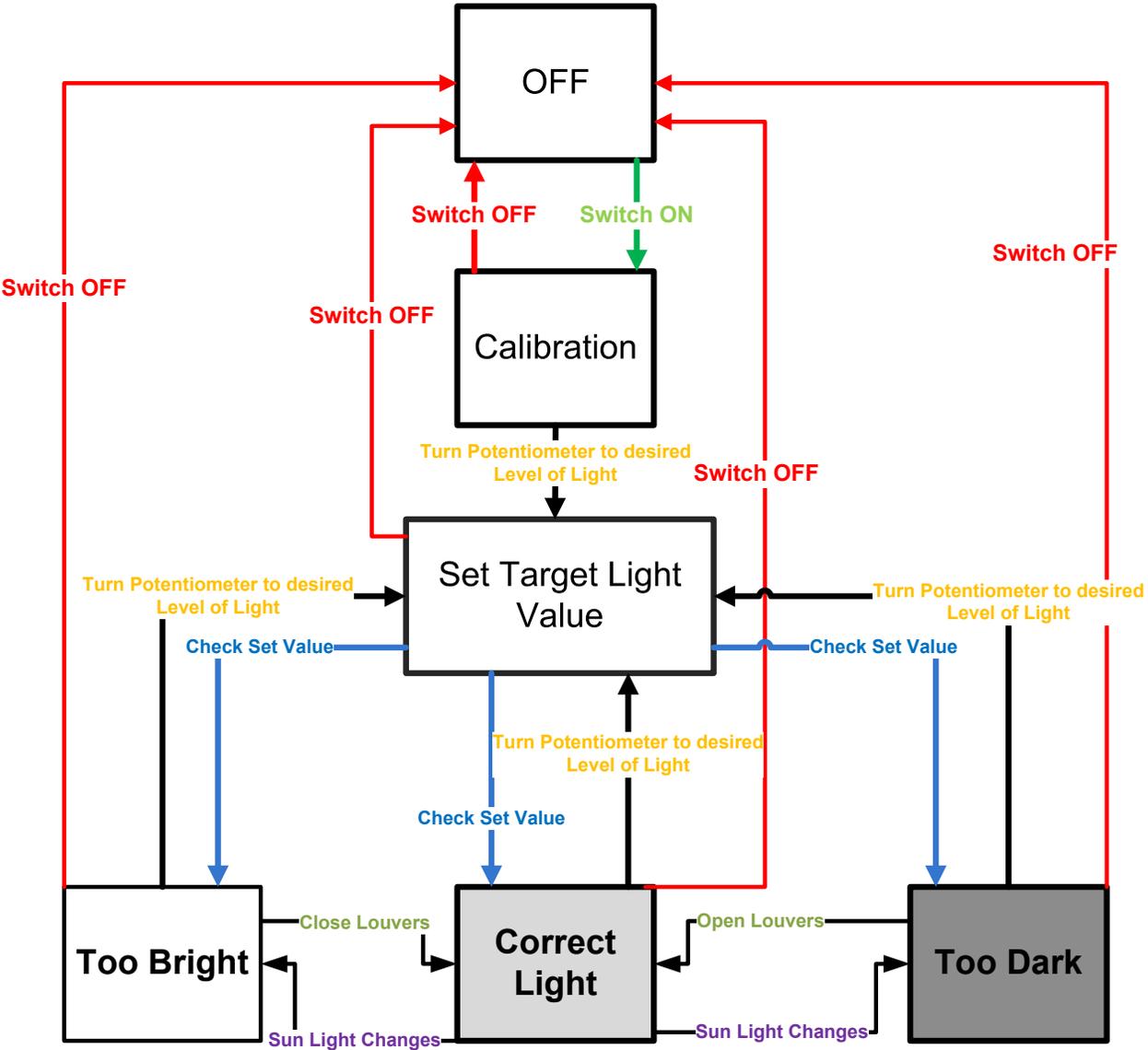
Smart Louver State Machine

This is a state machine for my final project. It will be used in an automatic louver system that is able to adjust the level of light within a space. A user can set the amount of light that they want in a room and the louvers will control the amount of sunlight within the space.

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