EECE 200 DESIGN PROJECT

REPORT GRADE SHEET

TEAM NUMBER ____33____

Percent of Effort Distribution and Team Approval			
Team Member 1			
Name _____Nadim Hachem_____	Percent Effort __30__ %	Signature	
Team Member 2			
Name _____Karim Chehab_____	Percent Effort __30__ %	Signature	
Team Member 3			
Name _____Wajeb Saab_____	Percent Effort __30__ %	Signature	
Team Member 4			
Name _____Sabine Haddad_____	Percent Effort __10__ %	Signature	

Expected Features	
This grading sheet as the front page of the report.	/15
Title Page: everything centered including title, names, course, and date.	/15
Professionalism: double spacing, 11- or 12-point font, grammar, spelling, punctuation, language, consistency, writing tips followed.	/25
Table of Contents	/10
Lists of Figures and Tables	/15
Abstract or Executive Summary	/15
Introduction: Problem statement and objectives; specifications and constraints; report organization.	/15
Discussion of design process	/25
Scheduling and planning: Gantt Chart.	/20
Description of considered designs and final design (tables)	/30
Photo of design	/15
Testing and results	/25
Itemized cost summary in the form of a table or chart; comparison of anticipated cost from proposal with actual cost	/20
Individual contributions of each team member; what and how each team member contributed to this project.	/20
Conclusions and recommendations	/20
References	/15
Total Score	/300

Design Project Final Report

Green Office

Team Number: 33

Nadim Hachem

Karim Chehab

Wajeb Saab

Sabine Haddad

Course: EECE 200

Friday, January 28th 2011

Table of Contents

II-List of Figures:

- ***III-List Of Tables***

The demand for power and energy is increasing, and this increase is leading to the depletion or Earth's resources. To counter this, "Green" movements around the world are aiming to save our planet by promoting and encouraging the use of renewable energy while minimizing power consumption. But all is easier said than done, as complete conversion to renewable will not happen overnight, and in fact will take some time since it's still in its testing stages and has yet to overcome hurdles such as low effectiveness and gigantic installation cost. Moreover, minimizing energy consumption is never an easy thing to promote as people tend to favor comfort over the environment. Here is where the introduction of "smart" systems comes into play. Such systems would provide a balance between the user's satisfaction and the environment's safety, as they guarantee high efficiency as well as low energy consumption.

In our case, we are going after a specific situation which revolves around transforming the everyday office into a green office using a combination of computers, sensors, SPEEDY boards and interface boards.

In order to achieve our goal we had to write one software that would run on the PC; the remote site, and another running on the SPEEDY board; the local site. Using the LabView software we were able to write and implement those two software. Once the implementation was complete we went on to build the office model prototype which was made of wood. The sensors were split between 2 rooms in order to give the illusion of a bathroom and normal chamber; moreover a rotating door was put into service as well as staircases. Once synthetic testing was cleared we decided to run the testing on the model itself to see whether or not the office would act as intended, thus the SPEEDY and its interface board was connected together and to the

various inputs and outputs required between the sensors, the interface board, the SPEEDY and the PC…

The testing of the office revealed a few problems that were overcome within a day, and once those bugs were ironed out, the office was up and running with all the sensors and elements working as intended. Despite some technical problems we faced with the hardware, it was still important that we were able to achieve our goal of creating this Green Office.

What this shows is that with the use of preliminary software, hardware, and simple sensors we could make any office - or home for that matter - a Green and environmentally friendly one that offers cutting edge technology and automation. So imagine what one could accomplish with more advanced technological equipment! This leaves the question: If it's so easy, why doesn't everyone do it?

V-Introduction:

Earth's resources are becoming scarce; the reason behind this is that non-renewable elements serve as primary energy production source. Recently, the general tendency has been to find alternate power sources to replace the old and earth-threatening sources based on fossil fuels like Fuel and Natural Gaz. This very tendency has led to the appearance of the term ''Green'' which corresponds to environmental friendly production, and raise awareness to counter energy and resource wastes. In this context, our Green Office has been engineered in order to provide the ''Green'' office of the near future. This green office will offer automation of several functions included in the house through the combination of the SPEEDY-33 board, its interface board, A PC and a group of Sensors that include motion sensors and temperature sensors.

+ Project Objectives:

- Controlling several functions in the house through different sensors:

-Light sensors to control the intensity and mood.

-Temperature sensor to control the water heater.

-Motion sensor to control water pump.

+ Project Specifications:

-The office is controlled through the Speedy 33 in the local site and a remote site.

-The door indicator is made of two aluminum cables which will give either an open or closed circuit depending on the status of the door.

-The intensity of the external light controls the number of LEDs that are ON; the mood control the color of the working LEDs.

-The water pump turns on automatically when the Spring Force button is pressed.

-The water heater keeps the water temperature within a constant range.

-A seven segment display displays either the number of LEDs that is on or the amount of power consumed.

-A remote site displays the status of the doors and controls two special functions.

-The functionality of the remote can be tested by an independent switch.

✚ *Constraints:*

-The project has been accomplished through the work of 4 students.

-The office model used was shared between 2 groups, each with different software.

-The SPEEDY-33 board and its interface board were used in this project and kept hidden, as well as the wiring and the cables.

The report is divided into 3 Sections, an introduction, a Work Description section and a Conclusion.

- ### *Work Description:*

    -Design Process Discussion

    -Gantt Chart

    -Design Alternatives Discussion

    -Testing Conditions and Results of final design

    -Costs

    -Team Member's Contribution

- ### *Conclusion:*

    -Discussing the design performance and features that made it succeed.

-1 sentence mini conclusions about each previous section in the report.

-Present recommendations and design improvements that could be used in a

Second, future, build of the office.

VI-Work Description

A- Discussing the Design Process

i)Software

The first part of the design process following the brainstorming of desig n ideas, was the creation of the Software. This particular task involved the crea tion of VIs using LABView that will coordinate all the sensors, LEDs and what not. The project required us to build 2 separate VIs, one for the local site and o ne for the remote site. The Local site VI was initially done with My Computer as a target simply to get a basic idea, but was then adapted to the SPEEDY 33 board. Figure 1 shows a part the final Local Site VI with the SPEEDY 33 as th e target.
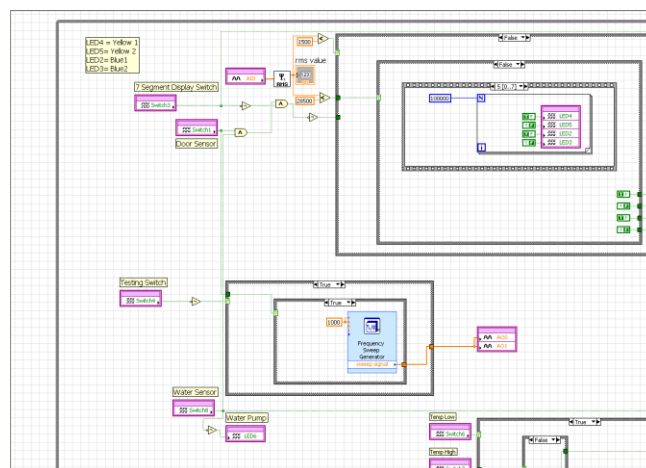
Figure 1

a) The Local Site Software

❖ *Local site software:*

- Tracks the door status and display it on the remote site.

- Correctly acquires data from spring motion sensor in order to

activate the water pump.

- Correctly switches the heater on or off depending on the readings of

the two temperature sensors.

- Correctly switches the internal lights on or off depending on the

exterior light intensity and the mood.

- Correctly switches between the two modes of the seven segment

display. (Number of lit LEDs / Level of power consumption).

-Disconnects communications with the remote site and simply display a lit

LED there when the corresponding switch is pressed.

- *__Door Status__*

    o Works only as long as the Test Switch is off.

    o A frequency of 1000Hz or 0Hz will be sent to the remote site if the door is open or closed respectively.

Figure 2 shows the VI on the Local site designed to send to the Remote site a specific signal through the SPEEDY's analogue outputs when the door is open.
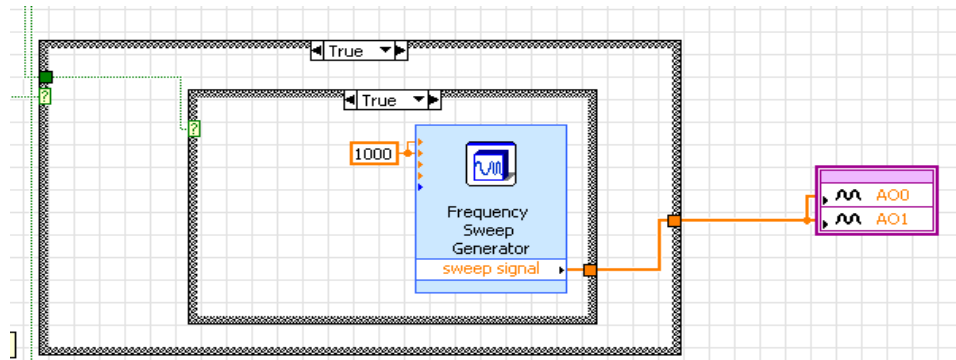
Figure 2
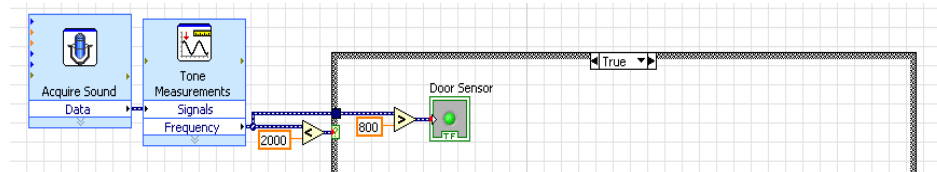
Figure 3

    o The remote site will display a lit LED accordingly if the door is open, as shown in Figure 3 where you can see that the PC is acquiring the signal send by the SPEEDY. In this case, the door is open.

- ### *Photo Sensor and Mood Switch*

    o The mood switch determines whether it's a leisure mood (yellow light) or a

    work mood (blue light).

    o The photo sensor determines the number of lit LEDs.

Intensity Switch	Mood Switch	Blue LED 1	Blue LED 2	Yellow LED 1	Yellow LED 2
0	0	1	0	0	0
0	1	0	0	1	0
1	0	1	1	0	0
1	1	0	0	1	1

Table 1
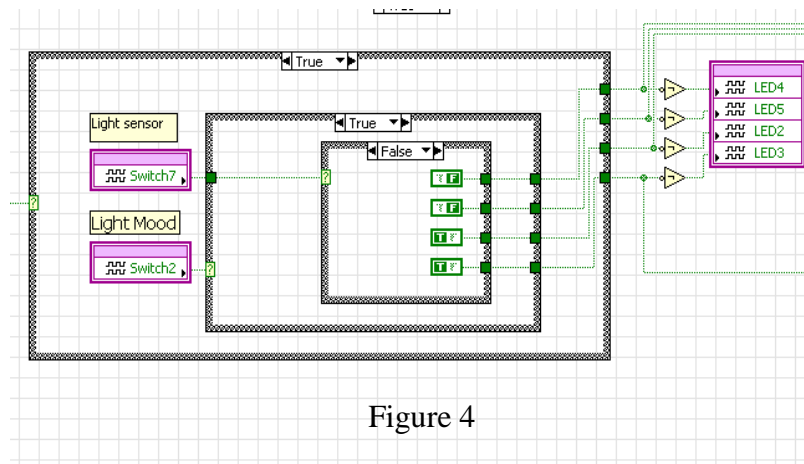
Figure 4

VI Used on the Local Site Software In order to correctly control the mood and the ignition of the LEDs.

-Heater

o   The heater operates according to the temperatures detected by the sensors.

o   Table 2 shows how the heater works after receiving data from the two temperatures sensors, sensor 1 corresponding to the low temperature sensor while sensor 2 corresponds to the high temperature sensor.

Sensor 1	Sensor 2	Previous State	Heater
0	0	-	1
1	0	1	1
1	0	0	0
1	1	-	0

Table 2

The previous state was obtained using shift registers.
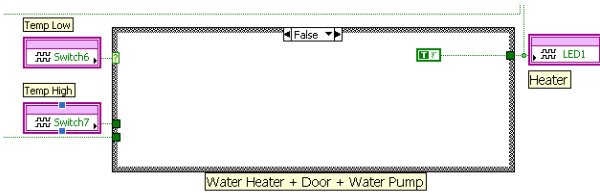
o   The heater is off.

Figure 5

o   The heater is on.
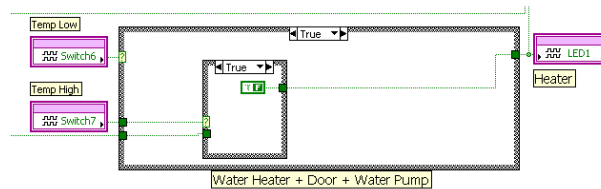
Figure 6

-*Water Sensor:*

        o The water pump is activated when the Spring Force Button is pressed.

        o The software is simply a DSP switch connected to a DSP LED.

-*Seven Segment Display Modes*

        o The Seven Segment Display has been programmed to show two different

           values through the ignition of a switch.
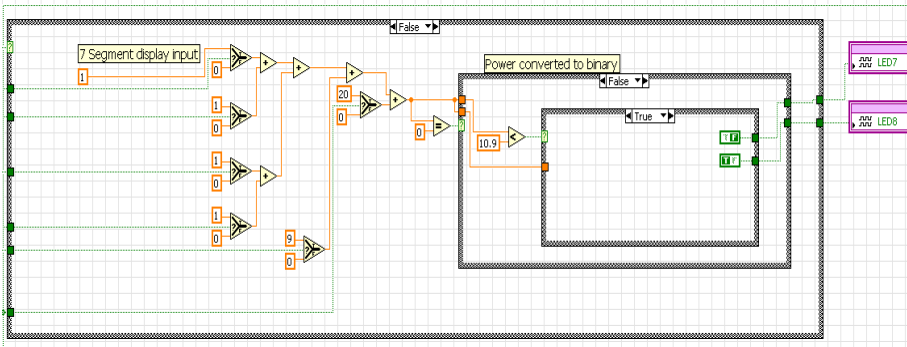
Figure 7

o Seven Segment display showing the Power consumed by the office.

o Seven Segment display showing the number of LEDs on.
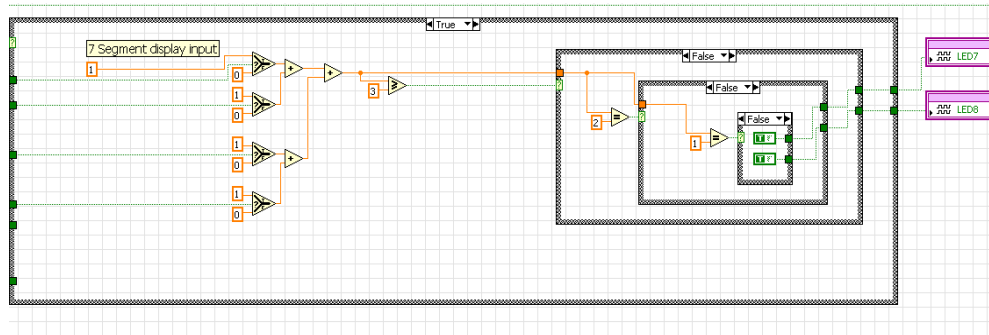
Figure 8

-*Testing Switch*

-It stops communication with the remote site.

-It displays a lit LED on the remote site for testing purposes.
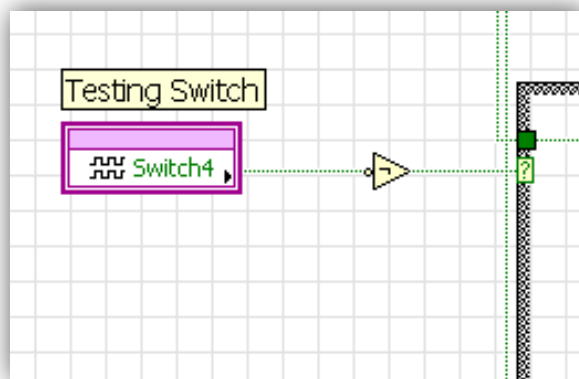
Figure 9

b)The Remote Site Software

o The remote site's primary functions are display the status of the

  door and activate the crazy feature of the LEDs.

o These functions will only work if the testing switch is off.

o If it is on, a lit red LED will appear on the remote site.

o It Runs On My Computer As A target.
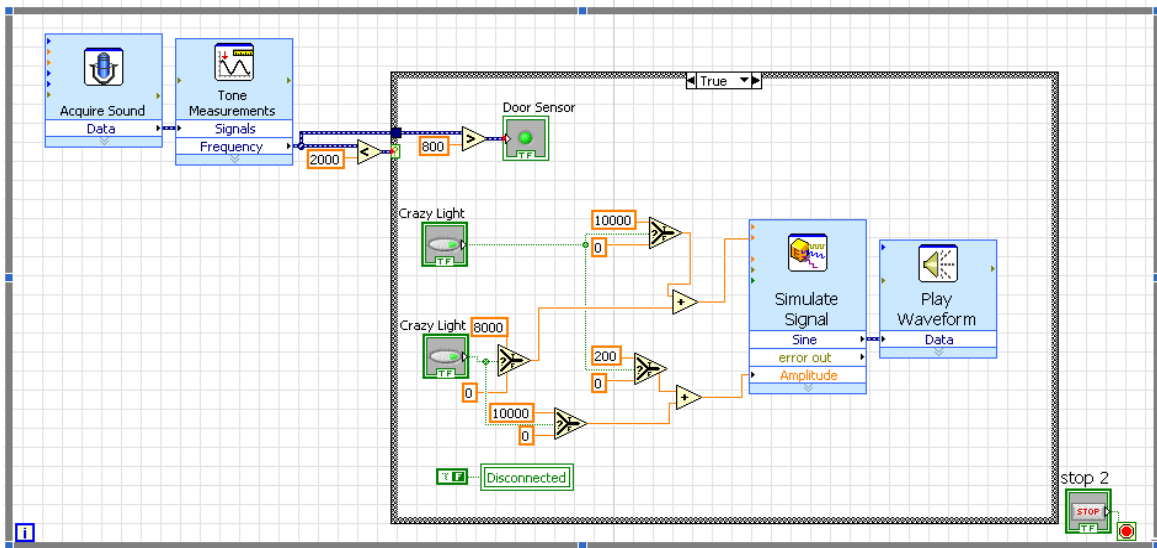
Figure 10

-Door Status

o The remote site displays the status of the door according to the received signal.

o In the case of Figure 11; The Door Is Closed.
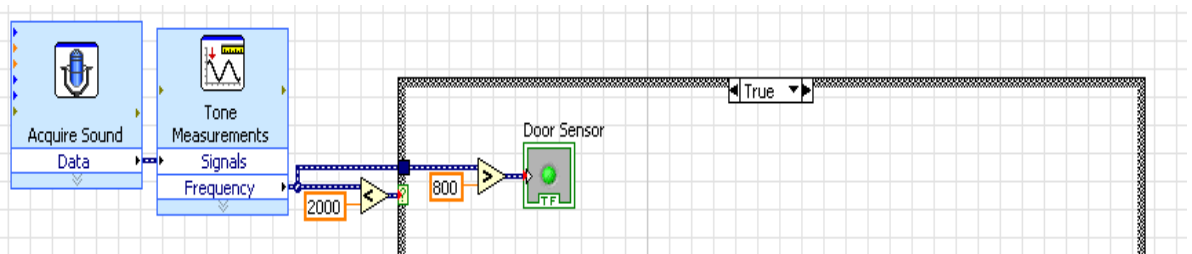
Figure 11

-Crazy Function

- o A virtual switch on the front panel of the remote site triggers the crazy functions.
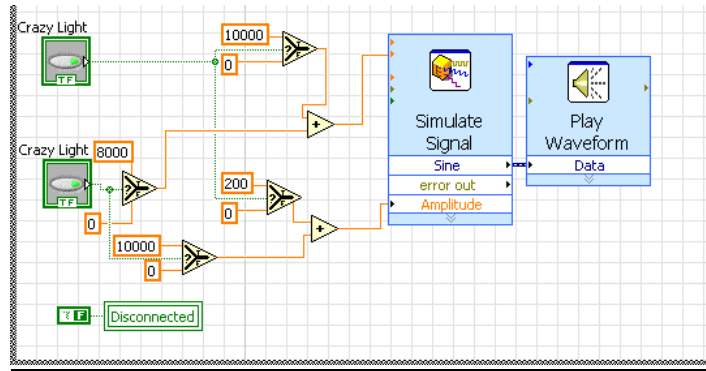
Figure 12

- o Comparing this signal's RMS value to a fixed value allows configuring the crazy features.

-Testing Switch

- o Communication is stopped with the local site.

- o A lit LED appears on the front Panel to make sure the Communication is working properly.
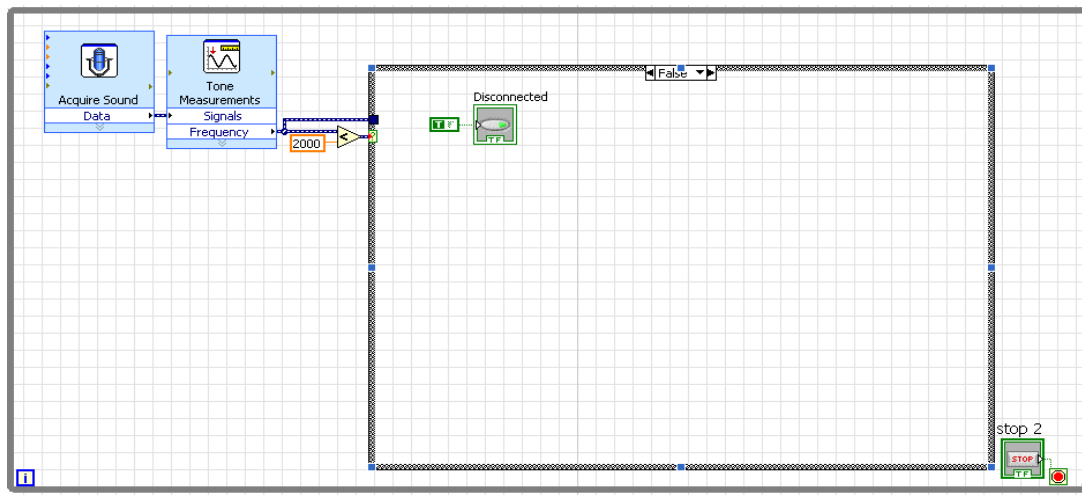
Figure 13

c)Special Features And Functions

After completing the required software for the office, we saw that we could dig in deeper in the software and create additional features and functions that complement the required ones. 3 Additional Features and functions were implemented:

- #### The Alarm System

    -The alarm system is designed to alert the residents of trespassing.

    -The alarm system is switched on when the seven segment display is on "Power Mode".

    - When the water pump is activated it means the person is in the toilet.

    -If the door indicator turns on while the water pump is on, lights go off.

    -Once the water pump stops, the lights turn on to provide vision.

- #### Heater LED Indicator

    -When the heater is turned on, a Red LED is lit in the bathroom to alert the resident that he has to turn the heater off before taking a bath: this is an example of multiple features connected to one output.
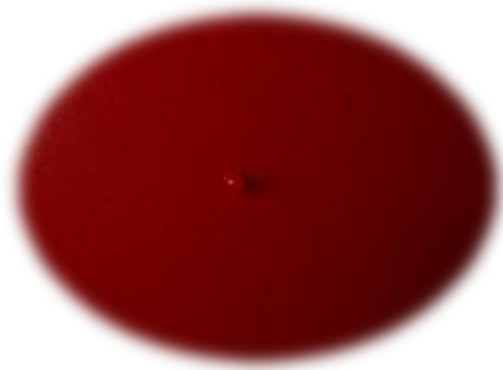
Figure 14

o *__Crazy Function 2__*

- Another switch on the remote site will send another signal to the local site.

- Pressing both switches together will send the sum of these two signals which will trigger a new different set of crazy functions.

- This is an example of changing the creative lighting sequence remotely.

- This feature will NOT work if the testing Switch is ON.

ii)Hardware:

1) The Local Site

The Second part of the design involved building, buying and assembling the hardware and materials we were going to use to build the office. The office is a wooden 0.8x0.5x0.5m model divided into two rooms, covered by two boards of Plexiglas with a 0.8x0.1m basement compartment.

Figure 15

This is the office without any wiring made to it, it is divided into two rooms in order to provide logical placement for the Water Pump and the heater which should normally create a bathroom that will accommodate the mentioned equipment.

Figure 16

- The first big room consists of 3 Testing Switches and the Seven Segment Display placed on the lower part of the center wall(Figure 16).

Figure 17

- 4 LEDs (Figure 17), 2 Blue and 2 Yellow sit above the 3 testing switches and Seven Segment Display.

Figure 18

- A sink and spring force button are placed in the second room to emulate a bathroom (Figure 18). The heater is in the water reservoir in order to heat the water accordingly.
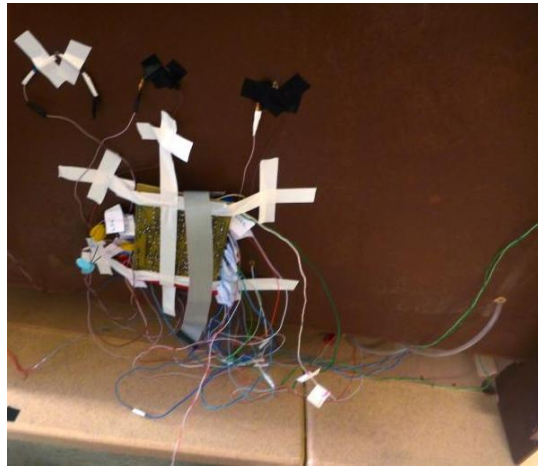
Figure 19

- The back of the office is removable. Once it is removed; the back is exposed; unveiling the Daughter board, the multiple cables and the 2 basements underneath the Office that serve as the location of the SPEEDY (Figure 19). Moreover, the light sensor is placed above the office, on the back management.

Rotating Mechanism

Wooden Door
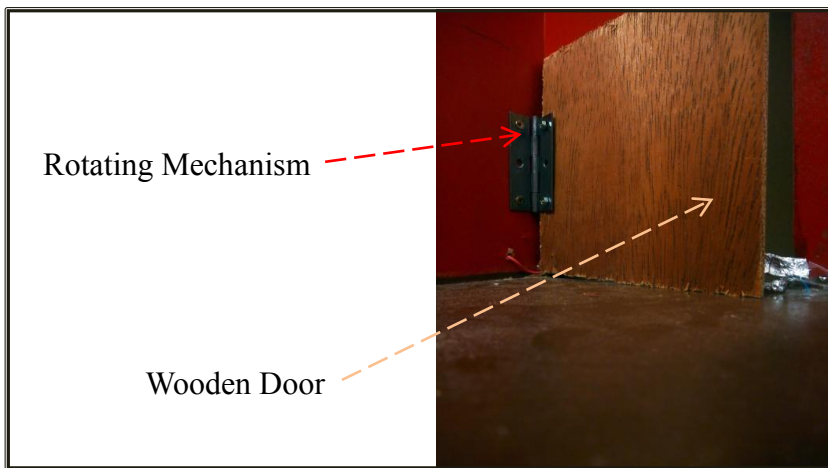
Figure 20

- The door is attached to a rotating mechanism. (Figure 20)
- The door indicator is made of two aluminum cables which will give either an open or closed circuit depending on the status of the door.

Figure 21
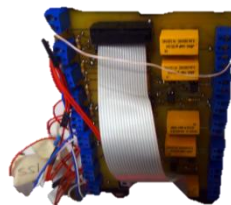
Figure 22

-As Seen in Figure 21, the SPEEDY-33 is connected to a Ribbon cable which serves as a bridge between it and the interface board shown in Figure 22.

The Interface Board Has a Total of 8 Digital Inputs labeled as follows:

Description	Label
Temperature Sensor H	TH1
	TH2
Temperature Sensor L	TL1
	TL2
Photo Sensor	PS1
	PS2
Water Sensor	WS1
	WS2
Seven Segment Mode	SS1
	SS2
Mood Switch	MS1
	MS2
Door Status	DS1
	DS2
Testing Switch	TS1
	TS2

Table 3:Digital Outputs

The Interface Board Has a Total of 8 Digital Outputs labeled as follows:

Description	Label
Water Heater	WH1
	WH2
Blue LED 1	LB1
	LB2
Blue LED 2	LB3
	LB4
Yellow LED 1	LY1
	LY2
Yellow LED 2	LY3
	LY4
Water Pump	WP1
	WP2

Table 4: Digital Outputs

2) The Remote Site

- o The remote site's VI will run on My Computer as a target.

- o It will communicate to the local site via 3.5mm analog audio cables (Figure 23)

  that will serve as signal carriers from and to the Local Site.

Figure 23

-Remote Site Inputs:

❖ The Remote Site will have only one analog input in the form of the microphone jack on

the PC (Figure 24)

Figure 24

-Remote Site Outputs:

❖ The Remote Site will have only one analog input in the form of the microphone jack of

the PC (Figure 25)

Figure 25

b)Gantt Chart
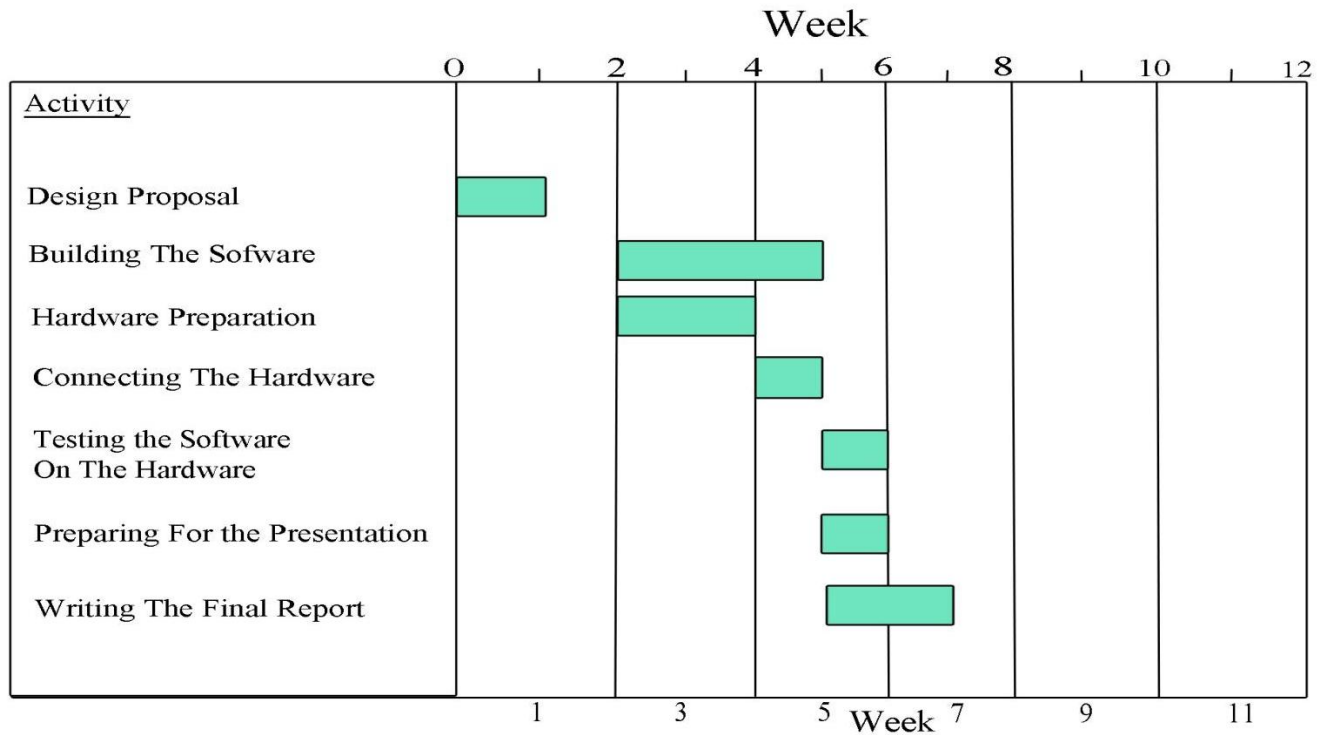
c) Alternative Design Discussion

1) Alternative Designs Dropped:

➢ **Design 1: Cell Phones**

Using a pair of Cell phones for transmission to and from the remote site: one implemented in a remote control one connected to SPEEDY, calling from 1 to 2 would trigger a specified ringtone based on a special frequency which is transmitted over a 3.5mm Cable towards the Audio-In port of the SPEEDY 33.

Advantages: Wireless Connection, Relatively Noise Free Transmission.

Disadvantages: Application difficulty and complex troubleshooting; continuous errors about frame sizes…

Rationale: While it seemed at first that the design's implementation would not present unwanted complexities, it did, and it slowed the VI, so It was decided to rule out the design.

➢ *Design 2: Plexiglas Usage*

As the title implies, the office would have been made out of Plexiglas instead of the wood we used in the final project.

Advantages: Gives the office a luxurious look as well as a modern one, transparency being one of the highlights.

Disadvantages: Very high cost with no benefits besides aesthetics, it also makes it difficult to hide wires.

Rationale: At the end we used two Plexiglas board as roof for the office, it wasn't all that expensive and gave the office the look we wanted it to have.

➢ *Design 3: Doubling the Number Of Output LEDs.*

The Design Involves connecting every LED output on the interface board to 2 LEDs instead of 1.

Advantages: Shows creativity and increases the number of LEDs used from 4 to 8, leading to better lightning.

Disadvantages: Increased power usage and complexity, no benefits beyond aesthetical ones.

Rationale: With added complexity and no real advantage we just couldn't find a reason to keep that design at all.

➤ ***Design 4: Microsoft's Kinect***

This design involves using Microsoft's Kinect Motion Sensing Camera to activate remote functions using hand or feet gestures.

Advantages: Modern Take on remote controller using hands-free connection.

Disadvantages: Kinect's drivers are not yet fully compatible with LABView's Visa USB input nor with the IMAQ Capture VIs, thus rendering the integration with LABView quite difficult and time consuming.

Rationale: While It may have given a fairly innovative and unique way of control, but what made us stop working on it later on, was the fact that LABView could not integrate 100% with the Kinect, and that motion based algorithms are time consuming to implement.

Check Appendices pages for more information about Kinect and its various uses.

2) Final Design:

The final design implied sticking back to what worked in the first place, but adding a few twists and unique functions along the way, such as an Alarm System, A Red Heater Indicator and a Second Crazy Light Sequence to complement the first. To activate the Crazy function we opted for the standard way of sending a signal of specified Amplitude and Frequency that travelled through a 3.5mm for minimal interference; when the SPEEDY measures the signal it will know to activate the Crazy function as instructed to it. The final office is made of wood, communicates with the remote site through 3.5mm audio cables, has 2 chambers, a door and a staircase.

Advantages: Wood construction allows great manipulation and no fear of breaking; it also offers some neat cable management opportunity as we did on our office with the back cover and it's cheap compared to the Plexiglas. The use of wires to transmit signals instead of cellphones allows for less noise corrupting the signal. The house is easy to access and modify from the inside and the outside and is spacious enough for comfortable work inside it. The heater has a separate Red LED to indicate if it's on in order to alert the person to turn the heater off before showering. The roof is made out of 2 blocks of Plexiglas which give a finer aesthetic to the office while not breaking the bank.

Disadvantages: The Plexiglas roof is not embedded with the office and can fall easily. When the back cover is removed the interface board and the cables are at risk of being caught up with someone causing them to fall, possible also breaking the Door status indicator made of aluminum.

Rationale: The final design of the office was the one who struck the best balance between usability, cost and ergonomics, signal transmission via Audio cables guarantee less interference, and the use of wood and Plexiglas gave the house we were looking for, not to forgot we were able to paint the house the way we wanted to.

d) Testing Conditions and Results Of Final Design

After having done all the wiring and ironing out all the problems in the software we went on to testing stage. The testing stage involved first wiring all the digital inputs and outputs to the interface board, then run a test program to determine whether the switches were working or not, and if the LEDs were being lit correctly. After a lengthy testing period it was deemed necessary to add inverters to all switchers because of the inversion of orders by the interface board. After synthetic testing was complete we decided to run the software on the office to eke out any errors or mistakes we may have committed. Testing went as planned, everything was running fine, but as noted earlier in the disadvantages of the design, our back panel was opened, exposing the wires and the interface board, and, alas, a person passing by tripped in the wires and caused the interface board to fall and some of the cables getting detached. But other than some loose cables the board was not affected, everything got rewired again and we were up and running again.

e) Costs

	Actual Costs				Proposal Estimates		
Item	**Quantity**	**Price Per Unit**	**Overall Price**	**Item**	**Quantity**	**Price per Unit**	**Overall Price**
Blue LED	2	0.5$	1$	Blue LED	2	1$	2$
Yellow LED	2	0.5$	1$	Yellow LED	2	1$	2$
Heater	1	2$	3$	Heater	1	15$	15$
Model	1	60$	60$	Model(Plexiglas)	1	50$	50$
Plexiglas	2	10$	20$				
Temperature Sensor	1	2$	2$	Temperature Sensor	2	2$	4$
Water Pump	1	2$	2$	Water Pump	1	10$	10$
Light Sensor	1	1$	1$	Light Sensor	1	2$	2$
Wires	1	3$	3$	Wires	1	4$	4$
Switch	3	0.5$	1.5$	Switch	3	3$	9$
SPEEDY-33	1	600$	600$	SPEEDY-33	1	600$	600$
				Kinect	1	250	250
		Total	696.5$			***Total***	948$

Table 5: Cost Comparison

.f)Team Member's Contribution

A- ***Nadim Hachem:*** Writing LabView code, testing the software and wiring the hardware. (30% Of The Workload)

B- ***Karim Chehab:*** Writing the Design Proposal, preparing the PowerPoint Presentation and producing the Final Report. (30% Of The Workload)

C- ***Wajeb Saab:*** Writing LabView code for office and testing on SPEEDY and on model. (30% Of The Workload)

D- ***Sabine Haddad:*** Getting the house and decorating it. (10% Of The Workload)

VII-Conclusion

The final design and the office performed as expected, everything ran as it should, every sensor, every piece of equipment, but alas, the risk of the model being beaten up or hit was very high, which resulted in a serious rip of the cables and the disconnection of many elements before the presentation due to the other group's mishandling of the office. The testing on the SPEEDY went as expected thus a better protection system is in order the next time around to prevent this incident from happening again. What made this design special though was the inclusion of 3 special features implemented smoothly with the rest of the functionality of the office. The alarm system showcased a great demonstration of sensor and data manipulation in a structured sequence, the Red LED heater showed how to conned 2 outputs to a single input while being useful, and finally the second Crazy Function display not only exceeded what was required (one crazy function) but also showed how we could remotely change the crazy lights functions. These extra functions combined with a removable back plate for better aesthetics and better access as well as 2 basements to house the Speedy proved how the office combined great looks, ergonomics and functionality into one simple and great looking package.

- o An Environmental friendly office was built using a SPEEDY-33 board, an interface board, a set of sensors, a PC and LABView.

- o 4 Students forming one group were involved in the completion of the software and Hardware.

- o The Office Has a Local And Remote Site To Operate.

- o The Software of Those 2 Sites Run Simultaneously in order to manage the office.

- o The Local Site controls the Water Heater, the 4 LEDs and the water pumps.

- The mood switch determines whether it's a leisure mood (yellow light) or a work mood (blue light).

- The heater operates according to the temperatures detected by the sensors.

- The water pump is activated when the Spring Force Button is pressed.

- Testing Switch stops communication with the remote site.

- The remote site's primary functions are to display the status of the door and activate the crazy feature of the LEDs.

- The remote site displays the status of the door according to the received signal.

- A virtual switch on the front panel of the remote site triggers the crazy functions.

- The alarm system is designed to alert the residents of trespassing.

- A red LED is lit in the bathroom to alert the resident that he has to turn the heater off before taking a bath.

- Changing the creative lighting sequence remotely through the Crazy Function 2.

- The office is a wooden 0.8x0.5x0.5m model divided into two rooms, covered by two boards of Plexiglas with a 0.8x0.1m basement compartment.

- The secondary room is the bathroom's equivalent; It contains the sink and a button which activates the water pump when pressed.

- The removable backside accommodates all the wires along with the SPEEDY-33 and the interface board.

- Numerous design alternatives were cancelled due to added complexity and negative effect on the software.

- Final design worked as intended with great efficiency and no major hiccups.

The SPEEDY's internal hardware is unable to handle big Vis, which somewhat limits the productivity and innovation that can be implemented, secondly, the interface board in the majority of the time were in need of repairs, thus a lot of time was wasted into just waiting for the board to be fixed, though it's not that much of a problem and it's the boards' fault; luck has its hands here.

In Conclusion, we were able to produce a smart office using relatively easy to use hardware and software, thus achieving our goal of building a green office without using extremely advanced and expensive material. This project showed how the implementation of green features are safe, easy to use and implement, and do not cost much money. If the green technology is available now, we must use it as massively and as quickly as possible before we face resource and power problems around the globe.

VIII-References:

- ### *AUB Moodle*

    -http://moodle.aub.edu.lb/mod/resource/view.php?id=131311

    -http://moodle.aub.edu.lb/mod/resource/view.php?id=226587

- ### *National Instruments*

    - http://www.ni.com/pdf/manuals/371297b.pdf

    - http://zone.ni.com/devzone/cda/tut/p/id/3503

- ### *Microsoft's Kinect:*

    - http://codelaboratories.com/kb/nui

- ### *Carnegie Mellon University*

   - http://www.ece.cmu.edu/~koopman/essays/abstract.html

-Using the Kinect in Labview.

The Kinect is a product created by Microsoft that essentially creates a 3D image that can perceive depth through the use of 2 cameras and an infrared monochromatic depth sensor; this allows Microsoft to use it for controller-free gaming on the Xbox. But since its USB connection is not protected, it can used for several other purposes.
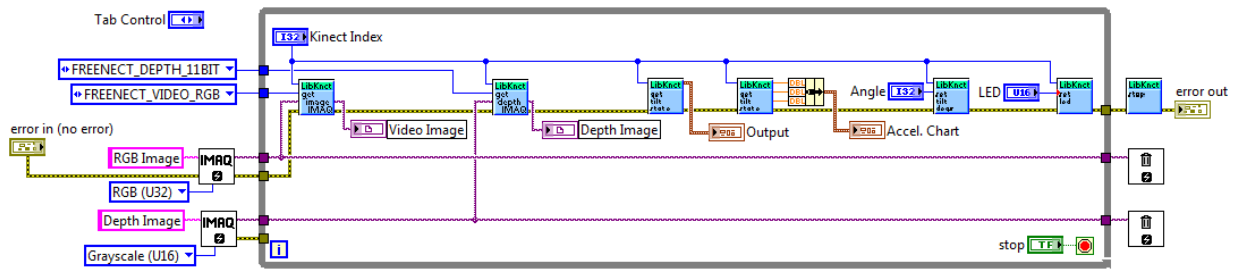
This is the VI in Labview that allows us to control the Kinect and acquire data from it.
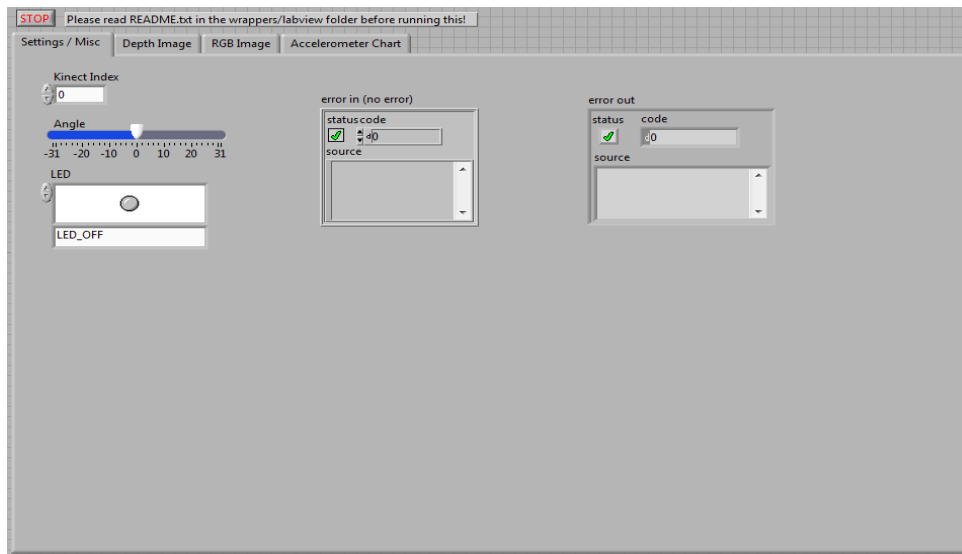
The front panel as it appears in Labview that allows us to change the multiple settings of the Kinect such as its LED functionality as well as its viewing angle.
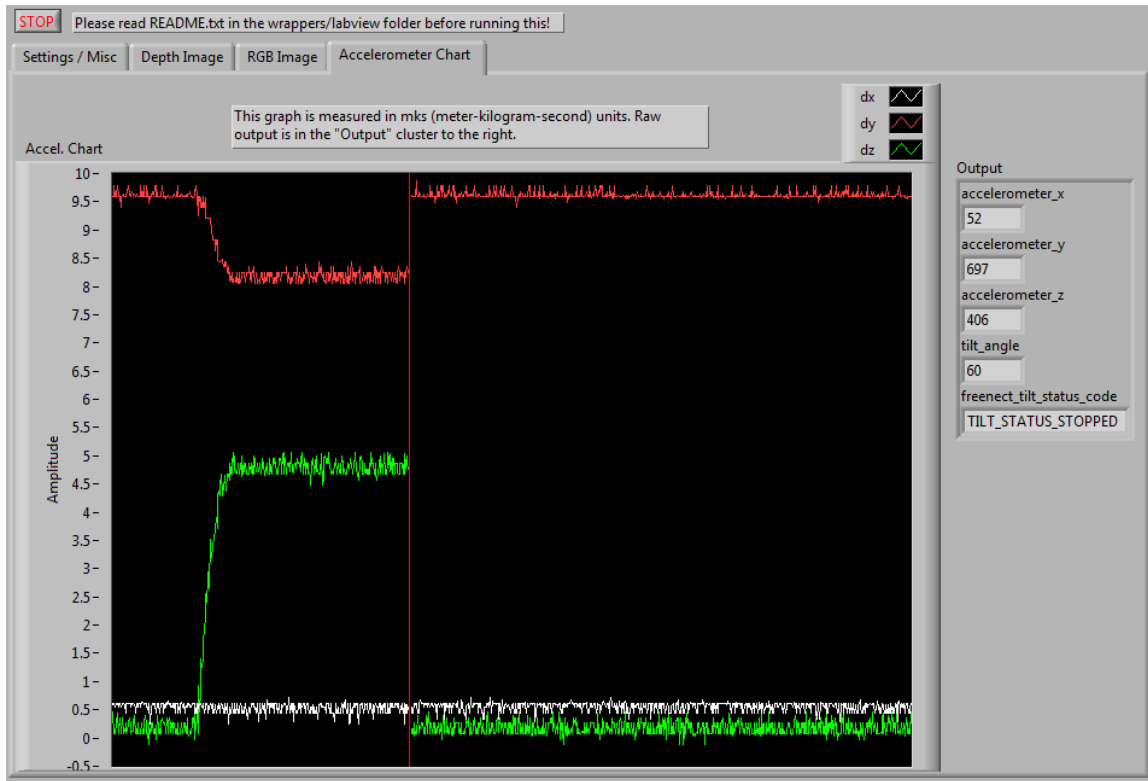
And finally here is the accelerometer chart displaying the amplitude of the X,Y and Z positions acquired by the Kinect through Labview.

To download this VI and read about it head for:

http://ryangordon.net/category/programming/labview/

For more information about what hacks are available head for:

http://www.kinecthacks.net/