



## Post Mortem

**Project Team:**

Dong Hao Zhuo  
Jiewen Mai  
Steven Ho Chong Zeng  
James Lee  
Jing Xiang Hou

**Primary Contact:**

Dong Hao Zhuo  
dzhuo@sfu.ca

**Submitted to:**

Andrew Rawicz – ENSC 440W  
Steve Whitmore – ENSC 305W  
School of Engineering Science  
Simon Fraser University

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## Introduction

Windows and curtains are used to ventilate buildings and maintain a balanced temperature. People are not able to open or close their windows and curtains when they are not around them. Many things are being automated these days because people don't want to worry about the little things in life such as closing a window during rain storms.

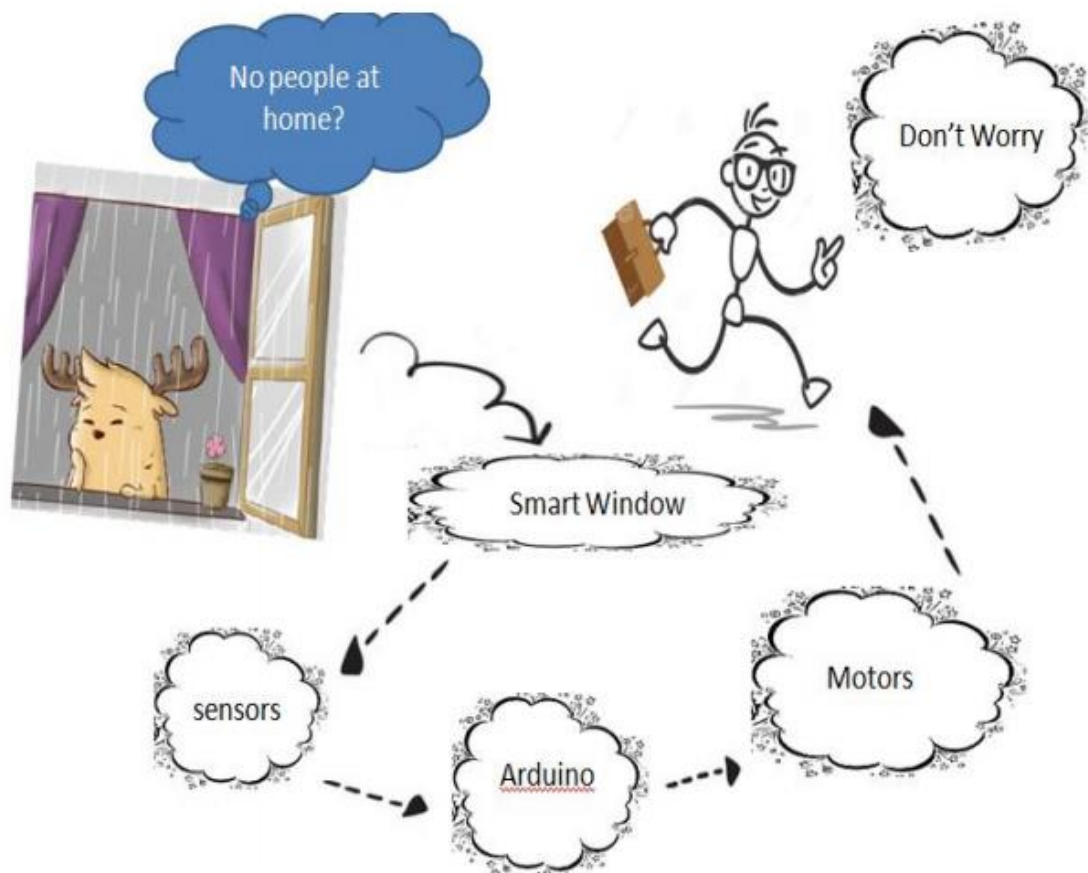
The main purpose of our product is to control the windows and curtains of homes and office buildings. In order to determine the indoor environment of buildings and offices we used rain sensors, temperature sensors, light sensors, and humidity sensors. The motors controlling the windows will adjust themselves based on these sensor values. It will cost us approximately 300 to 600 dollars depending on the functions that will be implemented. Our main customers are office, home, and apartment owners. We also plan on targeting industrial factories.

Currently, there are some similar products out in the market but they are expensive and not mass produced. Smart Windows aims to provide an affordable control system which is small and compacted.

The Automatic Window Controller (AWC) is a device used for ventilation in commercial buildings and residential homes. AWC controls the windows and curtains based on the indoor and outdoor environmental conditions. By sensing temperature, humidity, rain, and sunlight, the AWC can adjust the position of the window and curtain in a room to improve the living environment.

## System Overview

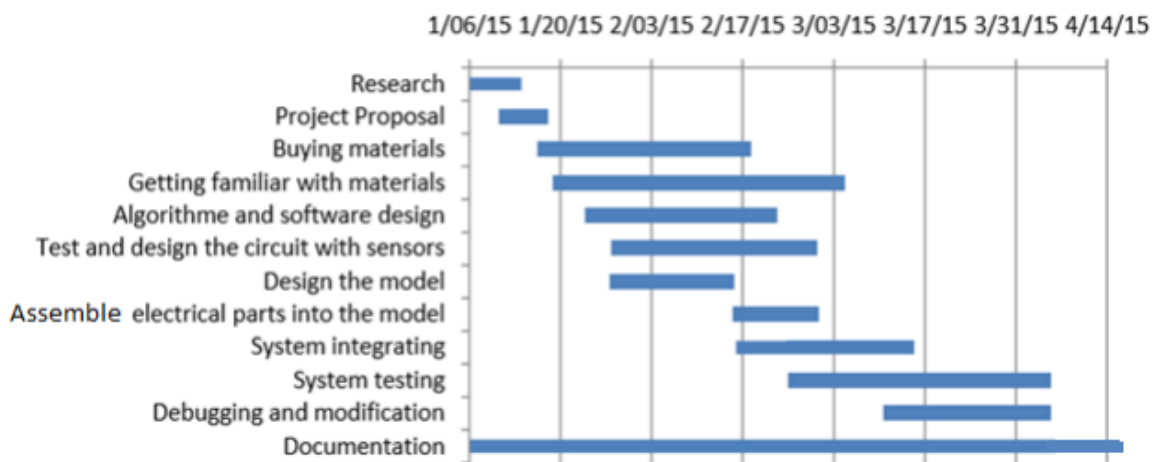
The Automatic Window Controller provides a multifunctional automation system. All of the weather sensors are programmed using the Arduino software. The Automatic Window Controller is able to alter the position of the gliding window in two directions based on the current weather conditions. For the ventilation, the awning window can be flipped open allowing air to flow and preventing rain from entering. Also, the LCD screen displays the temperature and mode of the system. The Automatic Window Controller can maintain a comfortable living environment even when users are not at home or when they are sleeping. The AWC can be put in manual mode to allow the windows to be cleaned or to adjust the position of the windows and curtains in special circumstances. This window is designed to be able to detect harmful gases. Once the detection of a smoke leakage is confirmed, the window will not be closed unless the system is shut down.



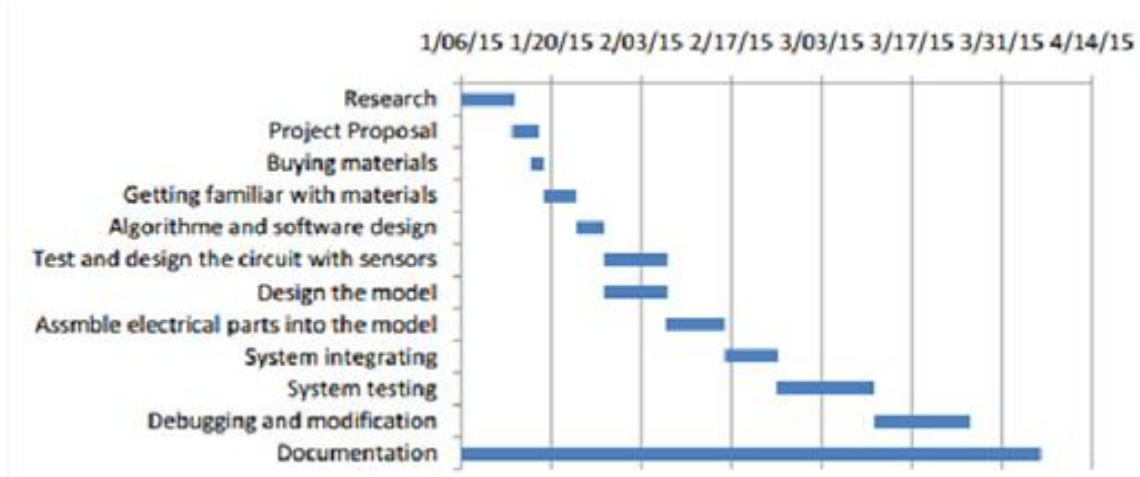
## Schedule

We realised that our original schedule shown in our proposal was unrealistic so we created a new one which is shown in the Gantt chart below. As we progressed we made some rearrangements to the schedule, however the time given to complete each part hasn't changed. The "Algorithm and software design" portion was moved below "Assemble electrical parts into the model". We have completed the project in time and successfully demoed it.

Actual Schedule



Estimated Schedule



## Financial

Components	Estimated Cost	Actual Cost
Batteries(3V, 9V)	\$15	\$38
4 Drivers	\$90	\$104
6 sensors	\$70	\$108
3 motors	\$80	\$94
Arduino Uno	\$30	\$32
Styrofoam	Not used	\$28
Frame and track	\$15	\$30
3D printed gear	\$100	\$free
Wires	free	\$15
LCD display	Not used	\$34
Remote	Not used	\$23
Battery holder	\$15	\$8
Boards	free	\$28
Curtain	\$50	\$40
Hydraulic	\$80	Not used
Decoration	\$20	\$38
Plywood	\$130	Not used
Total	\$690	\$631

We made some major changes to on the materials used to construct out house and windows, At first we wanted to use plywood for our house and use hydraulics to move our windows, however we decided to use Styrofoam instead as it was easiest to cut and assemble. We also decided to use motors and drivers to move the windows and curtains since our group has some experience designing gears.

## Challenges

During the development of our project, the automatic window controller our group had to overcome many challenges. One of the challenges we have to face was time conflicts during group meetings. While majority of our group was able to attend most of the meetings we had some members who were absent and had to work alone for majority of the project. To overcome this challenge communication was key. We started an online chat group within our group so that everyone can communicate with each other and have a better understanding of what needs to be accomplished.

## Group Dynamics

The group was split into two parts software and hardware. Steven and Vincent(Dong) worked closely together on the software while James and Jevon(Jie Wen) focused mainly on hardware. Aromis did whatever he can do to help out such as cleaning, cutting some plexy glass used for the windows, writing documentation, and research.

On the software part Steven programmed the LCD display, and remote controller while Vincent programmed the Automation part of the project. For the LCD display we had to make sure that no text overlaps and make the LCD unreadable. The position of the windows and curtain also need to be carefully calculated so that the window won't try to open further than it is suppose.

Jevon and James worked on the hardware part on the project. Jevon was the main designer for the mechanisms that are used to control the windows and curtains. Both Jevon and James worked on constructing the model house, windows, and curtain. The placement of each sensor also needs to be carefully decided for the demonstration.

Aromis worked mostly alone. He did whatever tasks that were placed upon him by each team member. He didn't have a main role as he did a little of everything.

Member	Role	Main Jobs
<u>Dong Hao Zhuo</u>	CEO	Programmer, House Assemble, Finance Management
Steven Ho Chong Zeng	VPO	Second Programmer, Documentation, Circuit Designer
<u>Jie Wen Mai</u>	CMO	Hardware Designer, Mechanical Designer, Builder
James Lee	CFO	Second Hardware Designer, Second Mechanical Designer
<u>Aromis Hou</u>	COO	Organizer, Documentation, Research



## Personal Reflections

### **Dong Hao Zhuo – Chief Executive Officer**

This course makes me learn lots of things including technical knowledge and teamwork interpersonal skill. Generally speaking, after this project I learned how to get well with a group of people and learned how to manage work for each group mate. Moreover, I also improved my time management skill since this course has a lot of tasks and we have to manage to do it couple weeks before the due day. Otherwise it is going to be tough for us. After we have done making the prototype and demonstration, we improved our friendship with my group mate. And also we became more confident to ourselves because we can finally finish what we trying to do and we achieved it. Therefore we feel very successful. This is also a good thing for us because we need to be confident when we are in a job interview.

During this project, I have learned lots of technical skills. For mechanical, I have learned how to use a gear and rack to control an object moving back and forward. And because of this, I got more familiar with using SolidWorks. For hardware, I have learned how to connect sensors to microcontroller and how to design a circuit to decrease noise. Moreover, I have learned soldering and making PCB. Those are all very good desire skill for me. For software part, I improved my C skill by programming the Arduino. During programming the prototype, I have to use lots of logic thinking and clear thinking to design the algorithm and loops. This is also a very good experience to practice my brain and push it to a higher level.

For my personal stuff, I found a co-op placement because of this project more or less. Because during the interview, I talked about the automatic window controller, the employer was very interested in the project and my personal skill.

Last but not the least, I improved very much of my writing and reading skill after this course. As we need to do lots of paperwork, such as function specification, design specification and project proposal. Because of this, I have so many opportunities to practice my writing skill and reading skill.

As a result, I am very happy SFU offers this course to me because this course brings me to a higher level of engineering. I improved my technical skill, interpersonal skill and writing skill. I also improved my leadership skill and communication skill.

### **Steven Ho Chong Zeng – Vice President of Operation**

There were many responsibilities placed upon me during this project. I worked closely with Vincent Zhou on the software part of the project. We coded majority of the code together. I believe my communication skill has improved greatly. Vincent and I were able to understand each other's point of view when it comes to the logical part of the code. Although we didn't always agreed with each other we were able to find a common ground and get the job done. Since we worked so heavily on the code we were also reasonable for doing research on each components used so we could integrate the hardware functions with our software code.

I also improved a lot in my circuit design and assembly skills. Since I was the only one with past experience on soldering I was given the task of soldering the board and making it sure works. The board we bought wasn't exactly what we needed however it was the one available to us. I had to do some thinking out of the box to make current connections works. At the end the final product functioned properly and the team was satisfied. This project has given me the opportunity to sharpen my soldering and circuit analyzation skills.

The work site for this project was in my home thus I was also responsible for managing the parts and making sure nothing gets damaged or lost. I became much better at organizing items and time management. Since the project was built in my house I needed to be available whenever a team member requests. That means I needed to set aside time for family, friends, other courses and projects. I also had to communicate with each member to ensure that we can find and suitable time to work.

From this project I gained more knowledge in programming, learned how to use the Arduino uno board and its components, strengthen my ability to solder parts and analyze circuits, increased my communication, organization, and time management skills.

**James (Chia Hung) Lee – Chief Financial Officer (CFO)**

This capstone project is the course that provides engineering undergraduate students an opportunity to implement the knowledge we learnt in SFU. Also, we did the proposal, function and design specification, and test plans to show our project. For this project, we experienced all the phases of Smart Windows from the first stage to the commercial stage. I felt satisfied when we finish each stage of the project. From this project, I learn lots of time and financial management, planning, and documentation for a project. The journal is actually a nice idea to keep us on track and organize the schedule. I learnt much about team work and dynamic to make the project go more fluidly. Everyone has his own expert area and responsibility in this project. We are not able to finish the product without anyone.

For the technical part, I had learnt a lot about how to use Arduino software. Al so, I gain the knowledge about the devices and components such as motors, drivers, sensors for implementing in Smart Windows. For hardware part, I experienced the skills of microcontrollers, PCB, soldering.

This course is an important opportunity for me to learn knowledge from every different discipline with other people. By finishing this project, I feel proud as an engineering student when I complete this achievement with what I learnt.

**Jiewen Mai – Chief Marketing Officer (CMO)**

This course makes me feel successful because we successfully integrated our prototype and finished what we expected to do. Because I used my hand a lot, so I increased my hand-on skill. Now I am able to build mechanical stuffs very fast. I also learned the combination of hardware, software and mechanical. Moreover, I have learned soldering because of this course.

During integrated the house, I have also improved my interpersonal skill. For example, I have learned how to get well with my teammates and communicate with them properly. Even though at the beginning, one of our teammate did less thing and I feel annoying. But in the middle of the semester I realized that we cannot ignore this situation. Then we talked to that guy and warned him that if he keeps doing like that, all of our marks will be decreased. After we talk to him, he worked harder and harder and we all work together dependently.

I also increased my money and time management. During we were going to buy materials, we collected the receipts every time we spent money. We got the funding from ESS as 600 dollars and everytime before we buy we consider how to manage the money to buy our material in 600 dollars. At the end, even though we over spent 30 dollars but we are successfully done what we expected.

As a result, I enjoyed the procedure of making our prototype and we share the happiness of success with my group-mate. And we enhanced our friendship. We planned to make our other project in the future because of this course.

## **Jing Xiang Hou – Chief Organization Officer (COO)**

When I decided to take Ensc 305/440, I didn't consider these two courses would be a challenge. The time proved I was wrong on this. Ensc 305/440 is not designed for students to only apply what they have learned from courses of four years or only follow the instructors' steps. What the instructors did is as a guide of self-developing study. It is in this form that we have learned teamwork, self-development, professional document writing, design skills and organization. Most importantly, I met a group of good friends who are creative, inspiring, hard-working and also friendly.

As the COO of Smart Windows, I am mainly responsible for research, documentation and organization. Also, I offered plenty of thoughts on every aspect of designing. At the beginning, my research gave several original ideas for the project topic. As the progress continues, my research serviced as counselor to the team to define our project. From programming to designing, my job is to collecting the information for the other teammates on their work. For instance, I researched the code and circuit design for single function of the AWC (Automatic Window Controller) for our programmer and hardware designer. In this case, even though I am not in charge of other works, I understand the contents of them.

The most challenging thing is to cooperate with members and stick in our schedule at the same time. Our team is slightly different, because I was the only one who is new to the group. The other four of the teammates knew each other and team-worked together. Sometime it could be uneasy to fit in and the other members had some sort of tacit agreement. It could be difficult if I didn't review my position in the team. At the start, I intended to be the programmer. Since I lived far from the other members, there were many chances for me to co-work with them often. So I decided to be responsible for more document and research work. It is in this experience, I've learned how to self-position for the group's interest.

I was lucky to work with such a great team. Even though we had some conflicts, everyone acted in good manners of understanding. I would like to thank everyone in the team personally. They did much real contribution than me, and they showed their appreciation to my abstract work.

## Conclusion

This project gave everyone an opportunity to put their knowledge of engineering to the test. As students, we learn mainly from lectures and textbooks, but in this course we had to do our own research, build our own product, and test our product. Our team was able to resolve conflicts we had with each other and successfully complete our tasks. We all earned valuable experiences that will help us in the future. We believe that the most important skill gained from this project was the ability to design and construct a product that hasn't been done before. While doing this project we felt less like students and more like real engineers.

## Appendix

### AGENDA

Dec 20, 2014

(13:00 – 17:30)

Tealips Café, Burnaby

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: Getting to know each other in the group and arrange the assignment

### MINUTES

i. Greeting and Knowing

Details: Greeting members and getting knowing with each one's skills, course schedule and other information.

ii. Arranging Assignment

Discussion: According to each member's course schedule, made decision on main meeting days of week. Temporarily assign responsibilities and work to members to get prepared for next meeting.

Decisions: Tuesday will be the main meeting day of week. We agreed on that we need two programmers, two circuit & model builders and one document editor. Each member is required to come up with at least two original ideas for the project.

## AGENDA

Jan 9, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: Decision on the project idea

## MINUTES

### i. Idea Arena

Ideas:

Tracking paster: a paster attaches on/in objects which can be easily found by sending signal to the patch. In return, the paster responses with data that shows the location on the user interface.

Pullover warning emitter: a device that precisely delivery pullover order to designated vehicle.

Automatic window: a window that will adjust its open angle and distance automatically according the environmental conditions.

And so on...

### ii. Brainstorm

Discussion: Advantages and disadvantages of all ideas are put the table to be compared. Feasibility, difficulty and expenditure were the major factors that affect our decision.

Decision: On consideration of all factors, the automatic window is decided to be our project. We decided to improve the project basing on this idea.



## AGENDA

Jan 12, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: Decision on the design of the prototype of the project

## MINUTES

### i. Basic functions

Discussion: The market of the project is the major topic of this meeting. Having discussed the major topic, the basic functions of the automatic window are named and selected on the list.

Decisions:

The main idea of our project is to build an embedded window system to serve on the room environment conditioning.

Basic Functions: The window detects the surrounding conditions as inputs, and then reacts according to those inputs. Environmental conditions like sunlight, rain, wind, temperature, air and humidity were considered as inputs for the window system. With response to the condition changes, the window will adjust its movable parts to keep the room environment in a comfortable situation.

### ii. Basic Assembly Parts

Window: The curtain is designed to response to the sunlight.

Curtain: The curtain is designed to response to the sunlight only. The type of the curtain was not decided yet.

## AGENDA

Jan 15, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: further decision on the design of the prototype of the project and the things to purchase

## MINUTES

### i. Further Design

Discussion: The improvement based on the previous design was discussed. Research assignment is assigned to each member for the coming funding persuasive presentation.

Decisions: The effective conditions are narrowed down to light, rain, smoke and temperature. Another window is added to solve complicated situations. The original window is named Gliding Window, and the added window is named called special window. The specific functions of the special window were not decided yet.

### ii. Purchase and Expenditure

Things to buy:

To build windows, glass and frame are expected to purchase. In addition, a scaled house model is decided to be built. Therefore, glue, plastic foam, wallpaper, thin plank had to be purchased. Most importantly, to build the control system and drive system, electronic units and other materials had to be purchased, for instance, sensors, motors, boards and wires.

Expenditure:

The initial expected cost of all is around \$600. The assignment for the group before next meeting is to seek for some approaches to minimize the cost.

## AGENDA

Jan 20, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: Final discussion and presentation exercise for the funding presentation

## MINUTES

### i. Final Discussion

Discussion: Details on the exact cost was discussed, from single costs to purchase places. Alternative purchase approaches had been listed as proofs that show our expected expenditure was necessary.

### ii. Exercise

Before the formal presentation, the Smart Windows group exercised the persuasive presentation for several times to ensure the funding is settled.

## AGENDA

Jan 22, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: Decision on the control system design

## MINUTES

### i. Arduino Board

Many control boards were considered in this meeting, like single chip for example. At the final, the Arduino board is selected among them. The reasons of choosing Arduino are in many aspects. First of all, the programming language for Arduino board is C/C++ which is manageable for five EE students. Further, the programming can be processed on the PCs and the program can be stored and run independently. Furthermore, the cost was fair and a reliable electronic store called Lee's Electronic had been discovered by one of the group members. The store sells most types of electronic components.

### ii. Prototype of the Control System

Based on the functions of the product, some quick researches were done during this meeting. Examples that performance the sensor data collecting, motor controlling and Arduino sample functions were found on the Internet. To build the actual control system, one Arduino board, one drive board, one motor and four types of sensors were needed, and wires as well.

## AGENDA

Jan 24, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: Electronic components purchase and proposal assignment

## MINUTES

### i. Purchase

The purchase place is called Lee's Electronic Components locating at 4522 Main St, Vancouver. All needed components were purchased as planned. In addition, the work staffs gave us much useful information and some important knowledge about the Arduino products.

### ii. Proposal

Each member had been assigned to several parts of the project proposal. Members were asked to finish as much as possible.

## AGENDA

Jan 29, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: To build a simple actual control circuit and get familiar with the Arduino products

## MINUTES

### i. Control Circuit

According to the research the group had, the control circuit consists of a main board, that is, the Arduino board, a driver and a motor. The driver the group used is called EasyDrive 4.4, and the point of adding the driver is to precisely control and power the motor.

### ii. Arduino Functions

To be acquainted with the Arduino board, some sample codes were simulated with different components. Sample codes like lightening control, input data reading and button input responding were run. And the Arduino board worked well.

## AGENDA

Feb 5, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: Further purchase plan and the functional specification

## MINUTES

### i. Further purchase

To drive two windows and a curtain, three motors and three drivers in total were required. The lab wires didn't work very well, so that wires of fine quality with pin nodes were the best choice. Also, some sensors seemed broken and the right power supply to the drivers was needed.

### ii. Functional specification

The group decided to start this document early since some midterms were on the way. As usual, each member was assigned to equal work.

## AGENDA

Feb 12, 2015  
(10:30 – 14:30)  
Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: Functional specification

## MINUTES

### i. Individual Work

Each member had his last work to finish his own parts. During this period, members shared information and discussed about the details in order to make individual works complementary to each other.

### ii. Assembly and editing

The document had been assembled in the order according to the table of contents. Steven edited the whole document to ensure the document appears professional.



## AGENDA

Feb 19, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: Further control system design and scaled model design

## MINUTES

### i. Control System Design

Discussion: Details on power supply, torque supply, movement speed and drive components were discussed in this meeting. The drive components can be ordered in 3D print. More components needed to purchase.

### ii. Layout

Discussion: Mostly this part is about layout of all assembly parts, including pathway of wires, areas of windows and curtain, position of the control circuit.

iii. The House Model

Discussion: Instead of a room or an apartment, a scaled house model is the best choice. The dimension of the house was discussed based on the dimensions of each assembly parts and the layout.

## AGENDA

Feb 22, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: More purchase and discussion on the circuit

## MINUTES

### i. Purchase

The location was still the Lee's. Those to realize the further design were purchased today. Again, some good advises were received from the work staffs.

### ii. Circuit

Discussion: Before this discussion, the group built the circuit on the learning patch board. Now the group decided to make the circuit PCB-like or arrange the circuit in order by soldering. Several means were discussed.

Decision: The soldering way, at the end, was chosen, since it is cheap and changeable.

## AGENDA

Feb 25, 2015  
(10:30 – 14:30)  
Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: Oral presentation

## MINUTES

i. Oral presentation

Discussion: The order and contents was the main topic in this meeting. Members of Smart Window chose their own sections and worked on them word by word. The rubric was used as a reference to modify the lines the group would present.

## AGENDA

Mar 3, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: To develop the control system and driver system

## MINUTES

### i. Control System

Issues: Before the windows and curtain was made, the torque needed for the motor was not determined. Furthermore, the code to control the speed of the motor and pin number seemed not enough on the Arduino board. And also, it appears some components were broken due to too much current flow.

Discussion: Discussion was mainly about those issues mentioned above and the solutions.

Decision: The group assigned each issue to every member to come up with solutions after this meeting.

ii. Drive System

The drive system includes the motors, gears, belts, racks and so on. Each part has its own dimensions and they were expected to fit to those which mechanically connected to each other. Also, the motors are bipolar stepper motors that are controlled by four input lines. Since the number of pins was not enough for three motors and sensor input, the option of motor mode had to be eliminated, which saves two pin positions for each motor.

## Agenda

Mar 7, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: More purchase and building scaled house model

## MINUTES

### i. Purchase

This purchase is mainly for materials to build the scaled house which is the frame for the Smart Windows' project.

### ii. Scaled House

The group split into two teams. One recorded dimensions of the model, and the other one worked on the programming. Once the dimensions were determined, one team was responsible for the house, the other one was in charge of the windows and curtain.

## Agenda

Mar 12, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: Design Specification

## MINUTES

### i. Meeting with TA

Before the meeting with the TA Mohammad, the group finished 90% of the design specification document. This meeting was to discuss this document and revise it with the help from the TA.

### ii. Revised Document

With each detail that the TA suggested to revise, the revision was divided into several tasks to each group member. The logo of the Smart Window had improved. The headers and footers of the document pages become comfort. Words, colors, numbers and symbols in the pictures were modified better.



## Agenda

Mar 18, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: Overall system testing and soldering

## MINUTES

### i. Test

The code of each function was complete. The steps for motors to turn and parameters indicating the situation were adjusted time by time after each test trial. Meanwhile, the code was being modified as well.

### ii. Soldering

Having completed each test task, the group confirmed the layout of the circuit. After discussion on the rough sketch of the layout, the soldering processed in the soldering sector in Lab 1.

## Agenda

Mar 26, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: To install the windows and performance the tests again

## MINUTES

### i. Real Test

The windows had been installed on the same side of the model. The codes were tested under this real condition. The environmental changes were simulated. And it resulted in good performances. The windows moved gently and smoothly, and they opened and closed to right positions according to the status.

### ii. Written Progress

This document was finished within an hour, since all progress was recorded and summed clearly so far.

## Agenda

Apr 2, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: To test the combined code

## MINUTES

### i. Combination

The codes for each function were complete long ago. This meeting is to combine these codes into one, and test it with the model. During the combination, the authority had to be named in order. The situations were described into simple cases and complicated cases in the previous document. With this help, the combined code would be improved with situation-detecting ability to respond to any environmental changes.

### ii. Test

The combined code was tested with the model under real situation simulation in several times. The result, as expected, satisfied the group.

## **Agenda**

Apr 7, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: Final test

## **MINUTES**

- i. Prepare for the final exams
- ii. if someone have time, keep on doing the documentation

## **Agenda**

Apr 14, 2015

(10:30 – 14:30)

Lab 4, SFU

Present: Vincent Zhuo, Steven Zeng, Aromis Hou, Jevon Mai, James Lee

Absent: None

Purpose of Meeting: To discuss the demo and presentation

## **MINUTES**

- i. Keep on doing the documentation
- ii. Prepare for the presentation
- iii. Final test on the prototype