An Investigation into: Displaying Sustainability

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Abstract

This report presents the design of the display boards that will be installed in the new SUB. The design is separated into three different parts. The LED energy data display system is a simple system that shows the energy usage of the new SUB; this system will compare and express the data in a way so that it has maximum impact on the SUB users' awareness of sustainability. The choice of televisions compares three different types television: LCD, LED, and plasma; the comparison judges different aspects of a television including contrast, colour, motion, viewing angle, and pricing. The content of the televisions suggests the programs that are going to be played on the televisions in the new SUB: a virtual tour, sustainability tip of the week, and tips for special events or holidays. Each section of this report is evaluated using the triple-bottom – line assessment, which includes the evaluation of social, environmental, and economical aspects.

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List of Abbreviations

SUB	*Student Union Building*
LCD	*Liquid Crystal Display*
LED	*Light Emitting Diode*
GHG	*Green House Gases*
CCFL	*Cold Cathode Fluorescent Lamps*

1.0 Introduction

The new AMS Student Union Building intends to bring new gathering space for UBC students and staff, as well as for the student services, right in the center of the university campus. However, this is not the one and only goal for this project. The new SUB committee has set ten major goals that the new SUB will aim to enhance, within those there are: "*Environmental sustainability by reducing the energy and materials consumed in the building and operation of the SUB"* and "*Economic sustainability by providing entrepreneurship opportunities for students and expanding the AMS business"* [8] pertinent to the sustainability factor.

In order to ensure the goals are met, the public and the users need to be aware of the concept of sustainability and become engaged in the project. For this purpose, a number of display boards are proposed for the main atrium of the building and other locations such as the cafeteria. The boards are to be as sustainable, eco-friendly and financially affordable as possible, while they need to function in an effective manner.

The following sections of the report will discuss the suggested design. LED arrays will constantly update and display daily energy usage data in the building. The other display board suggested is TVs, different types of which have also been assessed and compared, and finally, the best possible option has been chosen. Using TVs, other types of contents, such as movies, virtual tours and pictures can be displayed as well.

2.0 LED Energy Data Display System

The main purpose of this system is to constantly display and update the daily energy data of the new SUB using only LED light bulbs, and this system should increase users' awareness of sustainability. Such data can also be displayed on televisions; however, televisions cannot be used to only show the energy consumption data because other programs, such as advertisement, will be played occasionally. Also, the electricity usage of a LED TV is generally much higher than simple LED light bulbs. Although this system is designed to be very simple so that every user can understand easily, some features are implemented during the scaling, sizing, and choosing the colours. These features are believed to effectively increase the users' awareness of sustainability and make the system more interactive.

2.1 System designing

The only component required for this system is three different colours of LEDs: blue (490nm), green (565nm), and red (660nm). The size of LEDs will be 5mm, because they are the most common LED size and are relatively cheaper. There will be three different measurements being displayed: green-house-gas (GHG) emission, water consumption, and electricity usage. Each measurement will be displayed in different meters that are built with 10 blocks of LEDs. The area of one block is about 2.5x5 cm, which means that each block can be built with about 25 LEDs (see figure 1). The overall size of this system is expected to be about 80x100 cm. This system can be implemented as a replacement to one of the LED TVs; alternatively, if the size is increased to 2 to 3 times, this board can be implemented at the entrance of the new SUB atrium centre.

The LED blocks are the critical components of this system. If 5 blocks of LEDs are ON, then the new SUB is running at its expected usage or consumption; and if the value excesses or

reduces by a certain amount, the rest of the blocks will be turned ON or OFF respectively. Therefore, by reading the LED blocks, new SUB users will know if they are wasting too much energy or saving more energy for the earth.

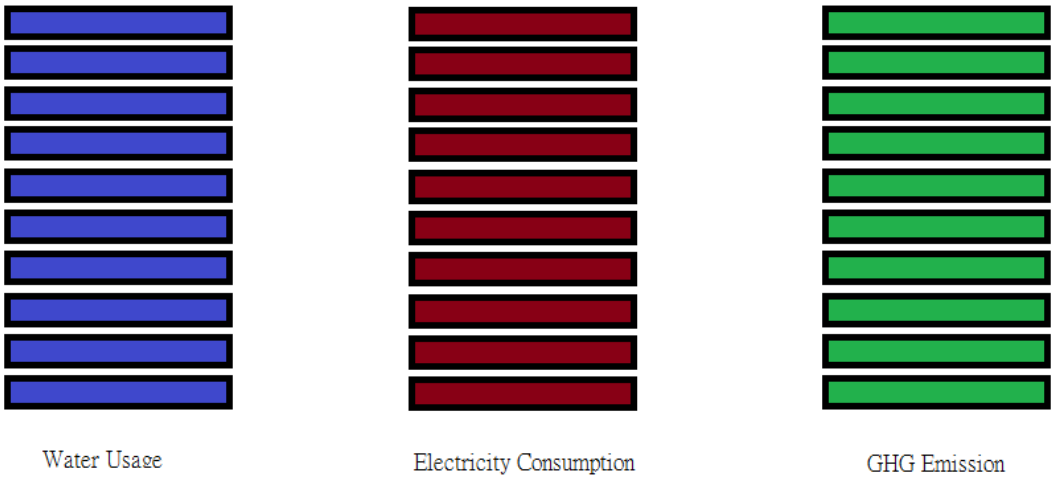

Figure 1. The design of the LED energy display system. (Hsuan Yu Wang, 2011)

2.1.1 Water Usage

The meter for water usage will be blue (490nm). This meter shows the overall water usage of the entire new SUB. One block of blue LEDs will represent 5200 litres of water. This amount of water is only enough for 10 Vancouver residents' daily use. However, 5200 litres of water is enough a Saharan African to use for more than a year.

2.1.2 Electricity Consumption

Red (660nm) LEDs will be used to display the electricity consumption of the new SUB building. The scaling for one block of red LEDs will be 1000KWh. This is the amount of electricity that a North American needs for one whole month.

2.1.3 Green-House-Gas Emission

Green (565nm) LEDs will be used to display the GHG emission of the new SUB building. Each green LED block symbolizes one ton of GHG. A tree planted in tropic can absorb about 22 kg per year, but trees might die or get destroyed during their lifetime. Therefore, Mr. Michael Bloch, the founder of the website "Green Living Tips", calculated that one ton of CO_2 is approximately equivalent to 5 trees.

2.2 System Evaluation

This system is evaluated using the triple-bottom-line assessment. A final decision is determined by three factors: social, environmental, and economic. Ideally, this product will have low impact to the environment; increase the users' awareness of sustainability; and low cost.

2.2.1 Social

Social impact is the priority concern when this system is being designed. The main objective of this system is to inform the users the difference they can make by converting blocks of LEDs to quantities that people can easily understand, such as number of trees. This system is believed to effectively reduce the energy waste by all users of the new SUB building. Nevertheless, the ultimate gold of this system is to encourage the users to reduce their daily energy consumption.

2.2.2 Environmental

Each LED consumes about 10 watts of electricity; this is about 1/10 of the energy that a traditional light bulb uses. This system contains only LED light bulbs, so the energy consumption of this system is considerably low. The average lifetime of LED light bulb ranged from 50,000 to 100,000 hours; light bulb replacement is not necessary for at least 5 years.

2.2.3 Economical

Again, the only component needed to build this system is LED light bulbs. The market price for them is about 75 cents each. The number of LEDs needed is depending on the size of the system. For an 80x100 cm board, this system would cost about $560 dollars. As the previous section comments, the maintenance (switching light bulbs) is not necessary for at least 5 years. Therefore, this system also has low maintenance fees.

3.0 Display board

In the current market, there are three main types of display boards that we will consider in our research. We will be comparing the advantages and disadvantages of each type, and conclude with the best solution possible using the triple bottom line.

3.1 Types

The three types of boards we will be discussing are LCD (liquid crystal display), LED (light-emitting diode), and plasma. An LCD television has liquid crystals placed in between the display panel and waiting to be activated through a supply of currents. On the other hand, LED television, with similar platform as LCD, uses light-emitting diodes as the back-light of the television. Whereas the LCD uses cold cathode fluorescent lamps (CCFL) back-light. Unlike LCD, plasma television works on a different platform. It is basically a sheet of cells placed between two glass panels that hold a mixture of noble gases. When current is applied, phosphors are excited, thus emitting light. All three types of television are different, yet very similar. We will be taking a closer look at different aspects of the three types of display.

3.2 Ranking

There are several aspects we have to consider when deciding the best type of television we purchase. We will be ranking all three types of televisions throughout all the categories.

3.2.1 Contrast Ratio

The contrast ratio indicates how well the device displays the difference between the darker and lighter areas on the screen. Generally, plasma televisions have better contrast ratio than LED, and LCD being the worst.

3.2.2 Color

Color is one of the most important considerations of television in people's mind. However, there is no clear winner this time. All three types of television are very similar in terms of the picture quality. Though differences may exists between two different models of the same type of television (higher priced television displays better color).

3.2.3 Motion

In the category of pictures in motion, plasma television is leading in front of LCD and LED. Although, LCD televisions have improved significantly throughout the recent years, but it is still losing compared to plasma. Also, LED televisions use the same technology as LCD.

3.2.4 Viewing Angle

The viewing angle represents the angle of which the image on the television screen can be viewed from. The higher the viewing angle, the better the television is, because this means more people will be able to watch the television from a wider range. In this category, plasma is the clear winner as it can be view from almost any angle. On the other hand, LCD is the worst out of the three.

3.2.5 Power Consumption

It is no doubt that LED televisions are the most energy efficient type out of the three, followed by LCD, with plasma falling behind.

3.2.6 Lifetime

LCD televisions are reported to have about 60,000 hours of lifespan, which translates to close to seven years. On the other hand, plasma televisions makers are trying their hardest to bring up its lifespan as close to LCD as possible. There are no actual figures of how long LED televisions can last, as it is a new technology and it would take more than 7 years to test its

lifespan (assuming it has the same, if not more, lifespan as a LCD television). Though, LED televisions are expected to have at least the same lifespan as LCD televisions.

3.2.7 Price

The budget is probably the number one priority for most of the people. In the past years, plasma televisions have much lower prices than LCD. However, as the increase in demand and production for LCD televisions, the prices start to get competitive for plasma. The most expensive type of the three is LED television. This is due to the fact that LED is a recent technology, and not yet produced at the same volume as LCD televisions.

	Best Choice	Second Choice	Worst Choice
Contrast Ratio	Plasma	LED	LCD
Viewing Angle	Plasma	LED	LCD
Color	No Differences		
Motion	Plasma	LED, LCD	
Power Consumption	LED	LCD	Plasma
Lifetime	LCD	Plasma	N/A
Price	Plasma	LCD	LED

Table 1: The ranking of three types of televisions (Alan Yen, 2011).

3.3 Evaluation

Looking at the chart above, there is no clear winner. In terms of price and picture quality, plasma is definitely the right choice to make. However, LED consumes much less power that plasma requires, which makes it a lot more environmental friendly. Another important aspect we need to consider is the social interest. Ultimately, we still have to decide which type of

television to purchase. Personally, I would suggest installing a plasma television first. After a few years, LED televisions will be mass produced, resulting in a drop in price, as well as having better picture quality since the technology advances. Then we can replace the old plasma television with the new LED television.

4.0 Contents of the Display Board

The social aspect of a new project is one of the most important sides of it that can lead to a successful program, having the display boards in the new SUB points towards this motive.

4.1 Design

The contents of the boards are, on the next level, what inform people about the concept of sustainability and present them with some useful data. These data will compare daily energy usage, water consumption and Green House Gases emission in the new SUB and the old SUB. But in order to have a more sustainable society, individuals will have to make some changes in their own life; therefore, having some data indicating how much water and electricity an average North American family consumes and how much garbage they produce, will help.

Figure 2: Displaying Data (Purchased from Fotolia By Nazafarin Shabehpour, Nov 2011)

Another feature that is interesting to be added to the contents of the display board is displaying short virtual tours of all the new sustainable features. A virtual tour is a simulation of an existing location or one that is under a change or construction. Virtual tours are widely used in real estate and architectural projects to give a better sense of the location without actually

having to be there. In the case of the new SUB, virtual tours can go behind the scenes and, for instance, show what happens when one steps on the pavegens, how electricity is generated and then displays the data of how much energy is generated and what is then done with the electricity produced; this will indirectly motivate people to use the sustainable features as such. This approach is especially effective if displayed in the cafeteria, where people have to spend at least ten minutes to eat, while most of the time, have nothing else to do a moving tour would draw their attention. There are numerous animation companies, who are specialized in producing animated virtual tours; within those there are:

- XR3D from Utah, United States. Pricing is, based on the complexity of the tour, from $50 to $70 per second. Their animations are pretty neat and precise. [1]
- Total Real from Zurich, Switzerland. Prices range from $6487 to $9369 depending on the length of the tour and number of projects. [11]

As another set of contents, "Sustainability tips of the week" is proposed. Tips such as "Reduce, Reuse, and Recycle", "Optimize your computer's energy-savings by setting it to automatically hibernate after several minutes of inactivity" and "Purchase reusable shopping bags and bring them with you every time you shop. If you are purchasing only a few items, stick them in your purse or briefcase rather than asking for a new plastic bag" are appropriate for this purpose. There could also be "Green tips for special arrangements"; sentences like "Most flowers are grown using large amounts of harmful pesticides. Purchase flowers that are organic and free from toxicity" and "Much like coffee farmers, cocoa farmers often work in very poor labour conditions. Purchase chocolates that are fair-trade and certified organic" can be displayed a few days before Christmas, Valentine's day, Mother's day, etc. and help people be able to think greener or maybe revise their gift ideas. [9]

4.2 Evaluation

This system is evaluated using the Triple-Bottom-Line assessment. Three factors of Social, Environmental and Economic impacts will make the final decision.

4.2.1 Social

Social impact is the number one priority in this design. The principal notion of the design is to enlighten people about sustainability and the sustainable attributes of the new SUB. Everything from the "tip of the week" to "Data displaying" follows the path towards the unique objective that is informing people and getting them to think Greener.

4.2.2 Environmental

The contents of the board encourage people to realize how much energy, money and natural resources they can save by thinking and living greener. By following the tips displayed and implementing them in their individual lives and maybe persuading others to pay attention to those tips will help save our communities and the planet.

4.2.3 Economical

The system is designed to work for a lifetime or as long as the building features are still working. The Data can be collected for a very little amount of money or for no charge; Sustainability tips can be found online for free or obtained from the CIRS. For the tour only there are options to consider,

- Can be done by a local or North American company, which would be about $4200 to $7000 for a minute of tour.
- Can be done by the architectural group that has the software for a little less.
- Can be done by students who are knowledgeable and interested, voluntarily.

5.0 Conclusion

Our goal is not only to select the best type of televisions using the triple-bottom-line guidelines, but also bringing sustainability awareness to the users of the new SUB. We first demonstrate the usage of water, electricity, and green-house-gas emissions with LED arrays. This reflects the users' efforts to hopefully reduce the amount of usage, as well as indicating how much can be wasted. On the other hand, we provide sustainability tips every week to users which aid them to be greener. Also, a virtual tour will be played in the cafeteria area where users can learn about all the new sustainability features. This will increase the usage of these new features and promoting sustainability awareness to our community. We believe after implementing all these concepts into the new SUB, users will be encouraged to take part in a sustainable lifestyle. Even though the steps we take right now are small, but as the steps accumulate, we will reach our goal of living a sustainable life.

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