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The usability of a product can be an ally of sustainability

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Abstract. Few steps like turning off the tap while brushing your teeth, turn off the lights when leaving a room, recycle waste or using recycling bags are considered sustainable attitudes. Sustainable development is one that meets the needs of the present generation without compromising the future generations and it doesn't deplete resources for the future. Consume with conscious is a sustainable habit and usability of products contributes to this. The goal of this paper is to prove that the usability of software contributes positivity or negativity for sustainability. By calculating the amount of electrical power dissipated by an electronic device, you can discover the amount of energy lost by it, and consequently, to relate this quantity with the amount charged by the concessionaire for each kWh of energy used. It was concluded that a software with low usability cause users to lose a lot of time interacting with it and thus spend more energy and money that goes against the concept of sustainability.

Keywords: usability, sustainability, usability test, power consumption

1. Introduction

Some attitudes like close de tap while brushing your teeth, turn off the lights when leaving the room, recycle the garbage or using recycle bags are considered sustainable attitudes. Nowadays, most of the world population is concerned to purchase sustainable products, those with low environmental impacts and high energy efficiency. Besides helping to preserve nature, the sustainable products represent an economy in the long term.

Sustainability is related to the continuity of social, economic, cultural and environmental aspects of society, including various levels of organization, from the local neighborhood to the entire planet. The usability of a product can be an ally of sustainability. Allowing that a software or a website that is easier, more efficient and more pleasant to use gives the user a positive experience, without delay or frustrate the achievement of a task. Software with good usability allows [3] a small number of attempts to complete a task and the number of commands that you execute. Spending less time interacting with the system, more energy is saved by the user.

2. Sustainability

The rate of environmental degradation and non-sustainable exploitation of natural resources are putting the existence of human beings in a very dangerous situation. The degradation caused by man is now compromising with the options of future generations. Those responsible for that in the present will not be here when the planet stars to feel the negative effects of their actions that causes rationing of water and electricity, global warming, reduction of the ozone layer, species extinction, destruction of forests and woodlands, among others. The consequences of human interference in nature will be depriving future generations to meet their own needs.

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Sustainability is related to the continuity of social, economic, cultural and environmental aspects of society, including various levels of organization, from the local neighborhood to the entire planet [9]. In 1983 the United Nations (UN) General Assembly created the World Commission on Environment and Development [11]. Emphasizing the need for a new approach to economic growth, as an essential prerequisite for eradication of poverty and for enhancing the resource base on which present and future generations depend, the commission drew up in 1987 the Brundtland Report, entitled Our Common Future . According to the Brundtland Report [1], sustainable development is "a process of change in which exploitation of resources, the direction of investments, the direction of technological development and institutional change are in agreement with the current and future needs".

According to the Report [1], the Commission had three objectives: to review the critical issues concerning environmental issues and development and to formulate realistic proposals to address them; propose new ways to convince the world of the importance of a reorientation of national and international policies towards sustainable development patterns, and give individuals, voluntary organizations, companies, institutes and governments a better understanding of these issues, encouraging them to act more firmly. The Commission focused its attention on the areas of population, food security, species and genetic resources extinction, energy, industry and human settlements.

Later, in 1992, the UN held in Rio de Janeiro the United Nations Conference on Environment and Development, known as Rio 92. According to the Ministry of the Environment [7], 179 countries agreed to sign Agenda 21, a program of actions based on a document of 40 chapters that constitute a comprehensive attempt to promote, on a planetary scale, sustainable development. [7] The Agenda 21 addresses the pressing problems of today and also aims at preparing the world for the challenges of the next century. It reflects a global consensus and political commitment at the highest levels on development and environmental cooperation.

The Agenda 21 has consolidated the idea that development and environmental conservation should be an inseparable duo, which promotes the breakdown of the old pattern of economic growth, compatibilizing two great aspirations of the end of the century: the right to development, especially for countries that remain in unsatisfactory levels of income and wealth, and the right to enjoyment of life in a healthy environment for future generations [7].

At the beginning of the millennium was approved the United Nations Millennium Declaration. [11] This document was approved during the realization of the 2000 Millennium Summit, in New York, and reflects the concerns of 147 Heads of State and Government. This Declaration was developed through months of conversation and has a number of concrete commitments, which were divided into eight goals, called the Millennium Development Goals.

The Millennium Development Goals will be achieved through the implementation of specific actions to combat poverty, associated with the promotion of health, sanitation, education, housing, gender equality and the environment. [4] There are eight goals with 18 targets and 48 measurable indicators proposed by experts from international organizations such as the International Monetary Fund and World Bank. The Fig. 1 provides an overview of the eight goals.

Figure 1
Eight goals to change the world

3. Usability

The International Standards Organization - ISO defines usability as the capacity of a product to be, in a given operational context, effective, efficient and satisfying [3]. Usability is the quality of the system that makes it easy to learn, easy to use, easy to remember, error tolerant and be pleasant to use [5]. The usability problems in software can be observed in the

way that it can delay and harm the accomplishment of a task, embarrassing or annoying the user.

To have the user's approval, the software needs to adapt its interface to different contexts and users behavior, to meet their expectations. To reduce the existence of usability problems is recommended usability testing. Usability testing is [6] a process in which representative participants assesses the degree to which a product is in relation to specific usability criteria. The usability testing is aimed at validating (or not) the chance of malfunction of the software evaluated, when applied to real work situations [10].

In usability testing users interact with the system performing tasks, previously chosen, and their behavior is observed to check the interface usability. It is recommended to define the usability metrics to assist in the evaluation. Metric of usability is used [13] to obtain quantitative and qualitative indicators related to the use of the software. Based on the interpretation of these metrics is possible to analyze and identify potential usability problems.

Usability testing can occur at different stages of software development: the exploration testing is performed when the software is still in a prototype stage; the evaluation testing occurs when the software is in the midst of its development, when the user performs basic tasks in the system; and test validation occurs before the software is released, to ensure its usability.

4. Software SIBIUN: case study

This paper evaluates the usability of the Integrated Library System from University of the Valley of Itajaí (SIBIUN in Portuguese) through a usability testing. The SIBIUN allows the user to loan, to renew and booking several materials, searching the database of the collection among other features [12]. It is used by teachers, students, staff and researchers from University of the Valley of Itajaí (UNIVALI).

The goal of usability testing is to present the user some of usability problems found in the software interface and, thus, help to acquire the quantitative indicators in order to perform the comparison of these indicators with the ideal indicators of performance.

Which are those where the user performs a task in the system and finds no usability problems that may delay or impair its performance. The ideal indicators were obtained when the user performed the task on the first try and executed the lowest number of commands.

4.1. Methodology

This article is based on a qualitative/quantitative descriptive research. The method used was the usability test that had 40 participants. During the usability test users had access to a list of tasks which included most frequently used functions in the system, in which the user should read and execute the tasks in a previously given order. After the test, the videos recorded by a logging software were studied and were obtained the time spent by the users during the tasks. The time that each user has dealt with the SIBIUN's usability problems interface were identified individually and, with the average of all times, the average time lost per user due the usability problems was identified. In order to determine the percentage of extra energy expended by a computer while the user was dealing with usability problems, it was used the formula of electrical power dissipated with the average time of those problems.

5. Calculation of electricity

To calculate the power consumed during a period of time is necessary to know the power of the electronic equipment used. The power value of the equipment can be found in the manufacturer's manual or written on the equipment. However, some devices may use a power higher or lower depending on their usage situation. In computers and stereos, for example, the power supplied by the manufacturer is not real, but the maximum it can achieve. In a computer, the power required for it depends on the amount of programs that are running, the model of the processor, the number of peripherals it has etc.

Therefore, to calculate the power of a computer was used online software called Extreme Power Supply Calculator [8]. This software requires the user to select the types of processors, the number of processor cores, the amount of RAM memory, the amount of hard drives and the number of revolutions per minute, the amount and types of drives, the amount of coolers and its size etc. There software has countless possibilities, including the newer processors on the market in its database.

The equipments used by the evaluator during the heuristic evaluation were: computer, mouse, keyboard and monitor. The software described above has already included the power required by the mouse and keyboard that are connected to the computer.

Table 1 has the description of each equipment and power in watts and kilowatts, where 1kW = 1000W:

Table 1
Description of the equipments

Equipment	Configuration	Electric Power
Computer	Intel Pentium 4 3000Mhz 1.4V, 2xDDR2, Nvidia Geforce 5600, HD 7200 RPM, DVD-RW/ DVD+RW, Floppy Drive, 2 FAN 80mm	286W
Monitor	LCD 18,5" Widescreen W1943 – LG	24W

To calculate the consumption of energy it's necessary to use two formulas [2]. First is the equation of Electric Power, see Eq. (1), where power P is in kilowatt, energy E is in kilowatts hour and time t is in hours. Second equation calculates the consumption of electricity in Real (Brazilian currency), where Cost and Tax is in Real, see Eq. (2).

$$P = \frac{E}{\Delta t} \rightarrow E = P \times \Delta t \tag{1}$$

$$Cost = E \times Tax \tag{2}$$

6. Results

Table 2 shows the ideal time, average time and usability problem's time of 40 users. The educational institution that provides the system has more than 25 thousands students [12]. Considering that 500 users accessing the system per day for 30 days, will be 15 thousands access to the system per month. If all these users do the two tasks "Locate the main page of the library" and "Find a book by author", for a total of six, and assuming that all users find the usability problems founded by the users of usability test (see Tables 2 and 3) the data used to calculate the energy consumption and the times used.

Table 2
Ideal time, average time and usability problem time

Task	Average (seconds)	Ideal time (s)	Usability problem's time (s)
1	02:25	00:20	02:05
2	03:29	01:02	02:27
3	04:41	00:45	02:56
4	03:18	01:56	01:22
5	02:17	00:35	01:42
6	01:27	00:22	01:05

Table 3
Data used to calculate the energy consumption

	Data
Average time spent due to the usability problems	0,0756h
Computer power	0,286kWh
Monitor power	0,024kWh
Total power used	(0,286*0,0756*15000) + (0,024*0,0756*15000) = 351,54kWh
Electricity Tax in São José (may, 2011)	R$0,359457
Cost	(351,54*0,359457) = R$126,36

For the users to access the library system and do the search for a book by the author's name, the university will be spending the amount of R$ 126,36 per month due to usability problems. If users want to loan a book they searched, the university will be spending more R$ 30,25 per month.

7. Conclusion

It was concluded that a new alternative to reduce the power consumption is to develop software interfaces and websites with greater usability. The usability problems found in theses interfaces make users spend more time using the software and thus waste more electricity. Some tasks that could be finished in 20 seconds, can last more than eight minutes as found in the experiment. The institution could save money if they invested in systems with good usability and more efficiency.

References

[1] Comissão Mundial sobre o Meio Ambiente e Desenvolvimento. Nosso Futuro Comum. Rio de Janeiro: Ed. da FGV, 1988. 430p.
[2] D. Halliday, R. Resnick and J. Walker, Fundamentos da Física, 7.ed, Rio de Janeiro: Livros Técnicos e Científicos, 2006.
[3] D. Te'eni, J. Carey and P. Zhang, Human-Computer Interaction: Developing Effective Organizational Information Systems. Hoboken: John Wiley & Sons, 2007.
[4] F. Cerqueira and M. Facchina. A Agenda 21 e os objetivos de Desenvolvimento do Milênio: as oportunidades para o nível local. 2005.
[5] J. Nielsen. Usability Engineering. São Francisco: Morgan Kaufman, 1994.
[6] K.G. Ferreira. Teste de Usabilidade. Belo Horizonte, 2002.
[7] M.C.L. Bezerra and M.A. Fernandes. Cidades Sustentáveis: subsidios à elaboração da Agenda 21 brasileira. Ministério do Meio Ambiente. Instituto Brasileiro do Meio Ambiente e dos Recursos Renováveis. Consórcio Parceria 21 IBAM-ISER-REDEH, 2000. 155p.

[8] Outer Vision Extreme. Extreme Power Suply Calculator Lite v2.5. Retrieved 31 may 2010 from: http://www.extreme.outervision.com/psucalculatorlite.jsp.
[9] Rede da Sustentabilidade. Portal da Sustentabilidade. Retrieved 31 may 2010 from: http://www.sustentabilidade.org.br/
[10] S.S. Moço. O uso de cenários como uma técnica de opoio para avaliações ergonômicas de softwares interativos. Florianópolis, 1996.
[11] United Nations. United Nations Millennium Declaration. United Nations Information Centre, Lisbon, 2000.
[12] University of the Valley of Itajaí. Institucional. Retrieved 2 march 2011 from: www.univali.br/institucional.
[13] W. Toscano. Métricas de Usabilidade. São Paulo: Exacta, v.4, n. especial, p-79-80, 25 nov. 2006.