User Frustration - The Problem and Possible Solutions

Meghavi Atul Doshi
Department of Electrical and Computer Engineering,
University of Auckland.
mdos002@ec.auckland.ac.nz

ABSTRACT
Frustration is defined as the emotional state resulting from the occurrence of an obstacle that prevents the achievement of a goal (Amsel, 1992). The severity of the frustration caused is dependent on the importance of the task or the outcome and the belief that the goal can be achieved. 'User Frustration' is the term used to denote the frustration caused to the user by a computer or its' usage.

This paper introduces the concept of user frustration and analyses some of the work done by the different research groups on this issue and the proposed solutions to reduce it in different scenarios. Some of these solutions include having an agent who empathises with user's frustration and acknowledges their emotions while another recommends a change in usability testing to identify more authentic factors causing user frustration within certain software.

Author Keywords
User frustration, social agent, user interface design

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Bessiere et al (Bessiere, Ceaparu, Lazar, Robinson & Shneiderman, 2002) describe what user frustration is and it's' responses. Hazlett (2003) proposes a biological approach on how to recognise when a user is frustrated. Once the user's emotion is detected as being frustration, an agent could be used to reduce user frustration. Several groups discussed in this paper have worked on different aspects of how an agent should work. One of the major differences between these works is how the user frustration is detected for the study. Klien et al (Klien, Moon & Picard, 2002) implemented an empathetic text-based agent that responded to the user frustration and attempted to make the user experience better. Jaksic et al (Jaksic, Branco, Stephenson & Encarnação, 2006) extend this concept to discuss the possibility that a "social agent" could be used to reduce user frustration. Hone (2006) conducts a thorough study to validate the reduction of frustration when using agents. Also, other properties of the agent are explored and it was found that embodied agents are better than text-based agents and that the female agents seemed to reduce more frustration than the male agents. Mandoza & Novick (2005) use user frustration as a measurement for usability testing for expert users.

WHAT IS USER FRUSTRATION
Bessiere et al (2002) investigate the cause and possible reactions of user frustration.

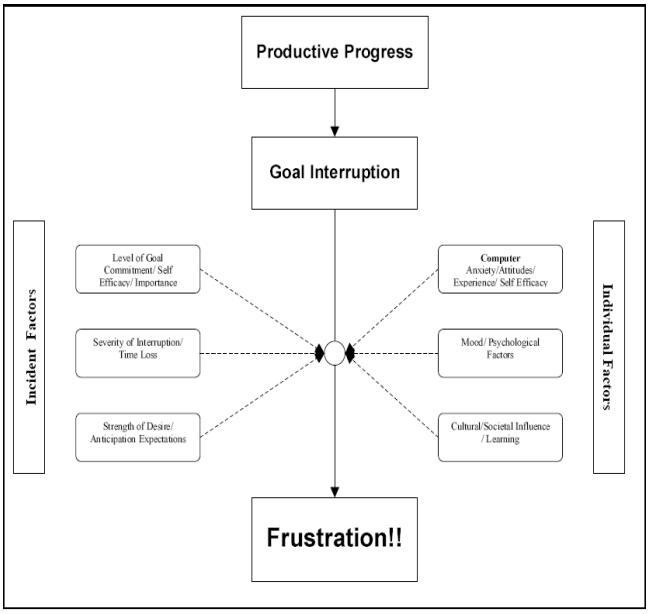

Figure 1: Computer Frustration Model

They argue that even if universal access to technology was achieved, users may still find it difficult to use. Even with up-to-date hardware and software, training, documentation and tech support users may get frustrated while using the computer. How the users deal with this frustration is dependent on several factors. These include importance of the task that was interrupted, frequency of the occurrence and the amount of time or work lost due to this problem. The importance of the goal, the desire to achieve it and the belief in one's personal capabilities (self-efficacy) affect the

level of goal commitment. The higher the level of goal commitment, the higher level of frustration is experienced by the user. Cultural factors also influence the level of frustration experienced. Another factor affecting the frustration level is the severity and the unexpectedness of the interruption. *Figure 1* shows a computer frustration model that highlights important factors affecting user's frustration levels.

The responses to the frustration are determined by cultural factors, the situation and the psychological characteristics of the individuals. These responses are categorized into objective and subjective responses. Objective responses include aggression, regression, withdrawal, fixation and resignation. Subjective responses include extrapunitive, intropunitive and impunitive. Extrapunitive is when the individual gets angry at something external, intropunitive is when individual blames themselves for the error and feels guilty, and impunitive is when the individual makes excuses for the problem. Bessiere et al (2002) suggest that some form of documentation/technical support should be provided that would help reduce the number the frustrating situations. Developers are advised to use appropriate error messages that inform the users what went wrong and how to appropriately respond in such a situation.

IDENTIFYING WHEN THE USER IS FRUSTRATED

Hazlett (2003) focuses on finding a biological approach to recognise the user's emotion including frustration. Hazlett gathers the biological data and calculates a Frustration Index.

The experiment comprises of placing tiny sensors on the user's specific facial tissues. This detects the minute changes in electrical activity in muscle tension and thus recognises changes in the user's emotional state. This is called electromyography (EMG). Hence, it detects a frown when eye brows are lower and thus associating it with a negative mood. Frustration index scores are calculated using such data.

Twenty eight female participants were asked to perform a series of five tasks on two different web sites - fifteen on one and thirteen on the other. The participant's were later asked to rate each task. The participant's rating, correctness of their tasks, time to achieve the task and number of pages they had to browse to achieve their tasks were compared with the other participants' data on the same. The tasks that were more frustrating than others were singled out. This data was than compared to the data gathered from EMG to see if it confirmed the changes in the participant's emotions. This was used to validate the Frustration index calculation.

This validation demonstrated that the Frustration index is reliable. Although this method of detect user's frustration seems theoretical sound, it should not be expected that the users would use sensors that are to be correctly placed on facial tissue to use a software. Also, this does not ensure that the frustration detected is only due the software the detection has to work for.

AGENT BASED SOLUTION

Although Klien et al (2002), Jaksic et al (2006) and Hone (2006) have researched on having an agent that responds to user frustration, their work varies. Each focuses on a different aspect/properties of the agent.

Computer That Responds to User Frustration

Klien et al (2002) focus their research on the possibility that computers can be designed to respond to users' negative feelings. They conducted an experiment where an (text-based) "agent" was used to express empathy and sympathy to help users recover from a frustrating situation. The agent's effectiveness was evaluated against two control situations, one where users' emotions were not taken into account and the other where users were able to report their problems and vent their feelings to the computer. It is argued that active emotional support like addressing the users' emotions can relieve the frustration quickly and effectively. Strategies that address the users' emotions are as follows:

- Actively solicit information about the individual's state
- Solicit information in a timely fashion
- Make sure the user is able to express what they feel
- Provide feedback, especially on emotional content
- Allow for repair if the feedback is judged wrong
- Convey sense of sympathy to the user
- Communicate a sense of empathy to the user as well
- Convey to the user the sense that their emotional state is valid.

The agent was designed to use all the above strategies. The experiment included the participants believing that they were testing a new computer game. The test was conducted in three different conditions during the game. Ignore condition ignored the user's emotional feelings while they were filling out a questionnaire while playing the game. Vent condition allowed the users to vent their feeling and affect-support condition participants were asked questions on their frustration levels and appropriate feedback was given by the computer. There were delays introduced in the game for some of the participants to induce user frustration. At the end of the test they were informed of the true nature of the experiment. The results revealed that the participants in the affect-support condition played longer than the users in either of the conditions. Thus, confirming that if a computer responds to user frustration then it could potentially increase productivity and give an overall better user experience.

Using Social Agents to Reduce User Frustration

Jaksic et al (2006) also conducted a usability test to measure the effectiveness of social agents in reducing

frustration levels. Although this test was similar to that of Klien et al (2002), it was more naïve and simplistic.

Jaksic et al used a social agent that was capable of speech and subtle facial expressions. This agent was placed in an e-commerce website from which the participants had to buy 10 items. Some broken links and errors were introduced in one version of the website thus inducing high level of frustration. The other version was working relatively correctly with very few broken links and induced only low levels of frustration. One group of participant's reactions were monitored and the agent was made to respond to the user accordingly. The other group only received navigation instructions from the social agent. The study ignored the results of the user that did not show any reaction to the frustration induced. The final results taken into account showed that the social agent in fact increased the frustration of the users that were already highly frustrated but it calmed the users that were only moderately frustrated. The users also suggested that the agent might work better in learning environment than in a shopping website. It was also recommended that the users be given an option to turn off the social agent as its' subtle movement could get distracting.

Empathetic Agents to Reduce User Frustration

Hone (2006) conducts three studies investigating different properties of an agent. These studies were heavily based on the research by Klien et al (2002). The difference between their experiments was when the agent is enabled and there was no control group in Hone's experiment.

All the three studies by Hone are conducted in the same manner, with only one variable condition - the appearance or the reaction of the agent. The participants were asked to play a game particular game on the web. This game was manipulated to induce some frustration. The participants were advised to click on a button when they felt frustrated while playing the game. At this stage, they were asked to rate their frustration. The agent would give some feedback.

In the first study, the participants were divided in two groups. One group's agent (affective agent) gave them a tailored feedback as per their frustration rating and the other group's agent only confirmed the participant's selection. This study was conducted with the following hypotheses:

H1: participants interacting with the affective agent will experience significant reductions in their self-rated frustration levels

H2: participants interacting with the affective agent will experience greater reductions in self-rated frustration levels than those in the control condition.

Statistical analysis of the data collected showed that both the hypotheses were true.

In the second study, the participants where again divided into two groups. One group interacted with a text based agent whereas the other group interacted with an embodied agent. The embodied agent, as per the popular choice in the pre-test poll, was a blonde lady with a text bubble next to her (*see Figure 2*). Both the agents were empathetic and said the same thing at the same level of frustration.

Figure 2: Female embodied empathetic agent - the blonde lady

This study was conducted on the following hypotheses:

H1: participants interacting with the text-based affective agent will experience significant reductions in their self-rated frustration levels

H2: participants interacting with the embodied affective agent will experience significant reductions in their self-rated frustration levels

H3: participants interacting with the embodied affective agent will experience greater reductions in self-rated frustration levels than those interacting with the text-based agent.

Statistical analysis of the data collected showed that all three hypotheses were true.

Figure 3: Male and Female empathetic agents

In the third study, the participants were again divided in two groups. One group's agent was a male embodied agent and the other group's agent was a female embodied agent (*see Figure 3*). Both the agents were empathetic and said the same thing at the same level of frustration.

The study conducted based on the following hypotheses:

H1: participants interacting with the male embodied affective agent will experience significant reductions in their self-rated frustration levels

H2: participants interacting with the female embodied affective agent will experience significant reductions in their self-rated frustration levels,

H3: participants interacting with the female embodied affective agent will experience greater reductions in self-rated frustration levels than those interacting with the male text-based agent.

The female embodied agents were chosen to have greater reduction because females are stereotypically considered more empathic than males.

Statistical analysis of the data collected showed that all three hypotheses were true.

Thus, Hone concludes that the empathetic agents help reduce the frustration levels, especially if it is a female embodied agent. Although it is also mentioned that there could be other factors affecting the latter study rather than just the gender of the agent, like the over-all appearance, clothes etc.

Evaluation of the Three Agent Based Solutions

In the study by Klien et al (2002), the participants are prompted by the computer enquiring about their frustration level. This is an unnatural method of acquiring this data and thus it might be distorted. In the study conducted by Jaksic et al (2006), the investigators remotely monitored the participant's reaction and forced the agent to react accordingly. This is also not the best idea since there is delay between when the reacts, the investigator assesses the reaction and then instructs the agent to react. Also, investigators may not necessarily have been able to witness and react to every reaction made by the participant. In the same study, the embodied agent was capable of subtle facial expressions which some of the participants found distracting. They also discarded the data on a participant that did not explicitly show any reaction. Hone (2006) allowed the participants to click on a button to enable the agent when they needed help. This meant that the agent response was timelier that the other approaches.

USER FRUSTRATION - A MEASUREMENT

Mendoza & Novick (2005) suggest that the current usability testing only accommodates for novice users. This does detect the causes of frustration is the long run. This can be done by a longitudinal examination of changes in usability over time i.e. monitor user performance over time while gradually increasing the complexities of the tasks assigned. It would reasonable for this study to go for six to eight weeks if the software is to be used regularly. This gives the participants sufficient time to become better than novices. User frustration is used a measurement to identify which area in the software needs refining. Essentially, issues they addressed are:

- Do users' levels of frustration caused by usability problems change as a function of experience with an application?
- Do the kinds of usability problems users encounter with a new system change over time as a function of use?
- Does the way user respond to usability problems change over time?

As per new regulations, middle-school teachers in Texas were meant to post certain information about their class and students on websites. The study was conducted when a new software named Home Page Designer was introduced and these teachers were expected to use it. Thirty two participants maintained a dairy that kept an account of the causes of their frustration and their frustration level. These accounts were reported weekly to the investigators.

These causes of frustration were classified into five sections, namely, Hard-to-Find Features, Missing Features, Operating System, Internet/Browser and Operator Error. All the causes that could be classified in the first four sections were placed in the Operator Error.

The data showed variation in different sections over time, mostly in the "hard-to-find" and "missing feature" section (*see Figure 4*). The data showed that the *hard-to-find* feature had more episodes in week thee and four because at that stage the participant would have been familiar with the basic tasks and would have been confident to try new functions.

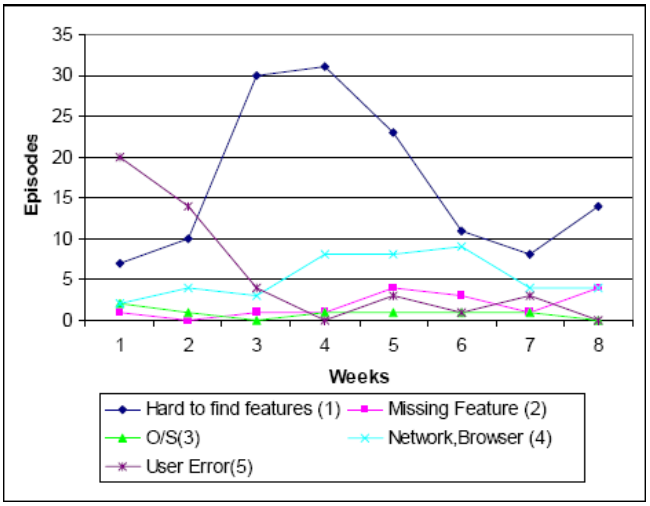

Figure 4: Results from 8 weeks of usability testing

User errors section had higher number of episodes during the first two weeks when the participant would be trying to get accustomed with the software. The number of *network errors* increased in week four, five and six due to participant's increased need for the use of network and browsers. Missing features peaked around week five because at that stage the participants had started to do complex tasks such as adding a calendar to the website.

This is how user frustration was used as measurement to observe changes in the usability of the software over time while the participant goes from being a novice to an expert. Also over time the average frustration level decreased and proficiency increased but statistically no correlation was found.

CONCLUSION

User frustration is caused when the users cannot achieve their goal or are facing obstacles towards goal attainment (Bessiere et al, 2002). Frustration can be auto-detected by monitoring certain facial tissues using tiny sensors (Hazlett, 2003). If the frustration is detected, then empathetic social agents could be used to reduce this frustration and give the users a better experience (Klien et al, 2002, Jaksic et al, 2006 & Hone, 2006). User frustration can also be used as a measurement in usability studies while discerning for trends (Mendoza & Novick, 2005). Although important issues and solutions have been established, there is still a lot of research to be done to achieve a system that could be practically used to detect and hence reduce user frustration.

FUTURE WORK

User frustration is indeed an issue that needs to be addressed by the software developers and other professionals in the industry. Although a social agent could be used to reduce the frustration levels, there is room for more research on how to effectively achieve this goal. This research is needed to address what methods could be effective in which situation.

There is also a need to find an effective and practical technique to detect user frustration so that these social agents could effectively be used at the correct time.

REFERENCES

Amsel, A., (1992). Frustration Theory. Cambridge University Press, Canada.

Bessiere, K., Ceaparu, I. Lazar, J., Robinson, J. & Shneiderman, B.. (2002). “Social and Psychological Influences on Computer User Frustration” In: Bucy, E., Newhagen, J. (Ed(s).), Media Access: Social and Psychological Dimensions of New Technology Use (pp 169-192). New Jersey: Lawrence Erlbaum Associates, Mahwah. Retrieved on March 26, 2008, from https://drum.umd.edu/dspace/retrieve/1330/CS-TR-4410.pdf

Hazlett, R. L.. (2003). “Measurement of User Frustration: A Biologic Approach.” Paper presented ay CHI Conference. Retrieved April 15, 2008, from http://portal.acm.org/citation.cfm?id=765958

Hone K.. (2006). “Empathic agents to reduce user frustration: The effects of varying agent characteristics.” Interacting with Computers, Volume 18, Issue 2, (pp 227-245). http://portal.acm.org/citation.cfm?id=1221013

Jaksic, N., Branco, P., Stephenson, P. & Encarnação, L. M.. (2006). “The Effectiveness of Social Agents in Reducing User Frustration.” Paper presented at CHI Conference. Retrieved March 26, 2008, from http://portal.acm.org/citation.cfm?id=1125451.1125629

Klein, J., Moon, Y. and Picard, R.W.. (2002 February). This computer responds to user frustration: theory, design and results. Interacting with Computers, Volume 14, Issue 2, (pp 119-140). http://affect.media.mit.edu/pdfs/02.klein-moon-picard.pdf

Medoza, V., Novick, D. G.. (2005). “Usability over Time.” Paper presented in SIGDOC. Retrieved April 15, 2008 from http://portal.acm.org/citation.cfm?id=1085348