With the advent of Internet of Things (IoT) and Ubiquitous computing (Weiser, 1993), the computation lies everywhere. The field of human-computer interaction confronts various challenges in managing the mammoth digital content that is increasing exponentially (Hollan, Hutchins, & Kirsh, 2000). Consequently, many discussions concentrate on making intelligent systems more usable (Grudin, 2009). The focus here is to aid development of autonomous systems, which not only complete tasks independently, but in a more collaborative and intuitive way possible (Heckerman & Horvitz, 1998; Horvitz & Barry, 1995; Horvitz, Breese, Heckerman, Hovel, & Rommelse, 1998; Lieberman, 1995; Maes, 1994).

Since there is direct partnership between the users and system, the usability and user experience plays an important role (Kraft, 2012). Incidentally, the key problem with such systems is to guess the goals and needs of the users (Horvitz, 1999). Nonetheless, there is a limited attention to usability of intelligent systems (Emmanouilidis, Taisch, & Kiritsis, 2014; Gil, Greaves, Hendler, & Hirsh, 2014; Pinelle & Wong, 2008).

According to Furguson & Allen (2007):

“A mixed-initiative system is one that allows the participants to contribute separately to help with group's overall success”

Such partnership depends on distribution of cognition and joint cognitive systems as an intellectual partnership. Nielsen (2010) defines usability using the five facets; learnability, memorability, efficiency, error, and satisfaction.

Consequently, the research question is:

How to improve the usability of the mixed-initiative systems by considering the facets of usability such as learnability, efficiency, memorability, errors, and satisfaction?

Error

Mixed-initiative system depends on intelligent systems to aid in user's task completion. Increasing task complexity with system complexity means more opportunities for malfunctions. This not only means more opportunities for humans to make mistakes but also means more cases where actions have unexpected and adverse consequences (Hollnagel & Woods, 2005). Simply defining errors as being any wrong user action does not take the varying impact of different errors into account. Since there is a degree of uncertainty involved because of multiple cognitive systems, the user might be unable to discover the error. The system should anticipate the error and help in preventing the user from committing the error.

Learnability

In a case study about the evaluation of spoken dialogue agents, the subjects had difficult time learning to use the mixed-initiative system, and the mean recognition score (performance of the speech recognizer), tended to be worse (Walker, Litman, Kamm, & Abella, 1998). Asynchronous nature of the system could be an important reason. The mixed-initiative systems are dependent upon the user's action to learn about them. Agents learn novel ways of performing tasks and help in solving problems. The agents should continue to learn by observing (Horvitz, 1999) with minimal intervention.

Efficiency

Joint activity (Clark, 1996; Cohen & Levesque, 1994; Grosz & Sidner, 1988) embodies an especially fluid and efficient form of mixed-initiative interaction (Allen, Guinn, & Horvtz, 1999). Identifying appropriate metaphors that promote efficient grounding by providing an optimum way for users, and the agent to communicate the contribution to a solution for a problem, or a task can benefit the overall efficiency (Horvitz, 1999b). The essence of mixed initiative is built upon to avoid or reduce the direct manipulation through which efficiencies can be gained with automated reasoning. This further reinforces the point that efficiency is a measure of time for task completion (Frøkjær, Hertzum, & Hornbæk, 2000). Moreover, providing efficient means to the user to terminate the automated services can improve efficiency (Horvitz, 1999).

Memorability

Effective joint cognitive system design mainly requires a problem driven approach rather than technology driven approach (Woods, 1985). According to Nielsen (2010), the memorability greatly depends on the type of usage. The design of mixed-initiative systems should be in such a way that upholds the working memory of interactions (Horvitz, 1999). By doing so, it can allow the users to make efficient natural references to the objects, which is a part of shared short-term experiences. This shared experience can reduce number of actions user needs to perform, therefore, fewer things to remember. Memorability is also directly linked to learnability (Jahn & Frank, 2004), therefore easing the learnability can have greater impact on memorability of the system as well.

Satisfaction

The attitude concerns the acceptable levels of human cost such as tiredness and effort. This is required so that users are satisfied enough to continue using the system (Benyon & Murray, 1993; Flavián, Guinalíu, & Gurrea, 2006). Subjective satisfaction depends on various factors, in essence, points to the pleasing nature of the application (Nielsen, 2010). One of the ways of achieving satisfaction in mixed-initiative systems is by providing automated services that offer genuine value over the solutions that are attainable through direct manipulation of the system. This effective integration (Horvitz, 1999) helps to establish trust, which in turn augments the satisfaction perceived by users (Bevan, 2009). Further, the intelligent system should intuitively anticipate the user's actions to make decisions on its own. This will introduce simplicity to the system, upholding satisfaction (Norman & Nielsen, 2016).

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