Communicating trust with the Machine: Utilizing Adaptive Multi-modal Interface Design by Technical Communicators for Artificial Intelligence

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Introduction

Technical Communication (TC) has undergone many changes since the time of weighty papers brimming with content deliverables and documentation. The tandem proliferation of smartphones and intelligent content suggests that the momentum of content throughput has sped up. Computer Science's (CS's) equally rapid pursuit of efficient AI (Artificial Intelligence) requires technical communicator inclusion to ground this efficiency of new communication in a natural dialogue that is "intuitive, flexible, robust, less cognitively taxing, and easily transferable" [9]. Although "the rate at which we are automating content is growing exponentially" [1] suggests TC's obsolescence through automation, "there will always be a need for the human understanding of where and how the customer experiences that content" [1]. One of our important contributions to collaboration can start in multi-modal interface design for systems utilizing artificial intelligence as we "pay special attention transparency and explanation" [8] and visual appeal when "the classical concept of aesthetics shows an overlap with attributes related to usability" [10].

Academics and practitioners of TC alike concern themselves with User Experience (UX), User Interface (UI) aesthetics and function, and ease of usability with a system through of our content. An *Intercom* article discusses this need in chat-bots stating that, "these technological advancements all improve the customer experience" [2]. They reduce the amount of effort required to find and act on information "blur[ing] the lines between humans and devices; and they make the overall digital experience more enjoyable" [2]. With respect to multi-modality (exposing users to multiple media), a trend has surfaced since the 20th century that TC can imbed rhetoric into cooperative interactive elements in computers to improve usability and UX through the UI experience. Just as multi-modality has reoriented our thinking of how users interact with our content, so too should AI be the logical step for TC to research and practice designing interfaces to improve and UX with AI.

For this reason I have studied how TC's can best utilize our own profession as machines become smarter, content becomes more dynamic, and UX with AI becomes dependent on the our ability to create functionally instinctive multi-modal UI. Essentially I am proposing that TCs take the best parts of AI and guise its functionality in a UI that feels personalized and unobtrusive. Through studies of end-user expectations/interactions, predictive environmental factors, and the utility of platform (be it PC, tablet, smartphone, or AR) [9, 10, 15] TC's are in the unique position to help integrate AI into society through well-constructed UI.

Practitioners Takeaway

TCs are well informed on how users interact with a system and have studied multi-modality as it relates to rhetorical execution of content delivery. Working with CS to structure AI into a functionally transparent UI necessitates our profession's attention to this growing technology regardless of current inadequacies and developmental issues [11] with HITL (Human In The Loop) systems [5]. Our unique understanding of end-user needs makes us suitable for nurturing AI into maturity by applying our understanding of UX design in UI

for the purposes of delivering effective intelligent content in an intuitive manner even on first impressions [10]. Though CS has largely studied AI, we cannot be negligent of our duty to adopt this evolving technology to better assist intelligent content delivery and end-user engagement. By applying our skills we can help simplify AI through UI that could be a simple Graphical User Interface (GUI) or a more complex Voice User Interface (VUI) [9] that is adaptive across platforms (multiple platforms) with considerations towards previous research prioritizing user cognition/expectations, environmental exploitations/limitations, and platform abilities/limitations [15].

Context

AI is an eventuality of technology stemming from automation of labor. As our needs become greater, technology has been created to address and react appropriately to suit these needs. For example, after Ford Motors created the assembly line process to streamline car manufacturing there was a desire to make this process effective in throughput and cost-efficiency which begets robotic armatures which can perform the more mundanely (even dangerous) procedures of vehicle assembly.

AI has a similar attraction of efficiency even at the lowest level of intelligence (Level 1) reacts in an "if A, then B manner." AI icons like chess-champion IBM's Deep Blue or Google's AlphaGo champion display these isolated reactive tendencies without storing memory for considering future decisions based on past experiences. Level 2 of AI displays limited memory and feeds this information as experience to inform future decisions for appropriate action regarding its limited world-view (such AI can been seen in chat-bots or self-driving vehicles). While there are two more levels, we will engage AI at level 2 (the most advanced in the present moment). These extensive levels of intelligence in robots are not the trope found in science fiction as both villain and hero. They are nuanced as these new tools, "technical writers [can] serve a vital role in development of AI applications… as subject experts most equipped to address content requirements" [3].

AI functionality and of cost-efficiency are topics human-computer interaction (HCI) fields have been feverishly studying as we consider how CS can build a functionally perfect AI that can deliver content without feeling like an automated phone system. Because HCI specialists address the human-computer dynamic, and TC is moving along similar lines with rhetorical studies in digital media [12], we see "focuses on collaboration between remotely-located people [where] AI brings to the picture collaboration between the user and the computer" [8]. HCI is studied to understand interaction with computer interfaces of multiple levels to increase usability and UX. Though the inadequacies of AI from researchers Lieberman [8] and Hintze [11] may give pause, news of AI adapting interfaces for disabled persons [13] and consumer products outfitted with this intelligence on self-driving cars [14] circulate showing a trend away from AI a catchall buzzword [7]. There is an active momentum of increasing end-user engagement with an interface teaching AI to respond to our needs. Our professions subject-matter expertise can continue classical instruction though tutorials with these machines as studies show "low user engagement can be the result of the user uncertainty as to the technology or the lack of proper training" [4].

Through studies of GUI's and VUI's [9], TCs and computer scientists are conducting exploratory usability impact surveys of human-robot engagement through multi-modal receptions of human input. These concepts of usability, aesthetics, UX, and intelligent content delivery reinforce the AI research through dynamic UI. AI, being such a large and developing field of CS, requires some knowledge of HCI (or Human-Machine Interaction in some circles) [8], AI abilities/limitations regarding HITL and HOTL (Human In the Loop) [6], and the ethical concerns of AI in society [5]. This concern of ethical transparency is familiar to TC where the function of clear communication for instruction safeguards unwanted incidents. Additionally, a person who could understand UX and UI design (with regards to audience analysis) would be able to interpret how to best ground AI complexities into an efficiently communicable "interfaces [that] can use AI techniques to recognize the user's intent implicitly" [8]. Usability testing and firm grounding in end-user expectations/limits are essential in this discourse of adaptive multi-modal UI for AI. Essentially a marriage of understanding practical AI, rather than depending on Sci-fi interpretations, and how human's best utilize UI for their present needs, is required to grasp the totality of this subject.

Theoretical Framework

Most TC practitioners and academics address the topics of multi-modality and user experience independent of the AI factor. Additionally, TC conversations of UI and UX don't delve too deeply into the realm of involvement with AI due to its growing pains. Apart from the occasional article which engages with AI as a futuristic element of TC discourse [3, 4, 15, 12], conversations on AI largely remain in the purview of cybernetics and multi-modal studies.

My own research is a way to reinvigorate the TC field by advocating promoting tandem UI development for AI to tame the unpredictable nature of these algorithmic agents [8, 11]. However, the erratic nature of AI has the advantageous function of being an "input amplifier" [8] for users whereby engaging with AI on a software (or robotic) level can be a dynamic feedback for user engagement [8]. My research and study are meant to resolve AI's current limitations by localizing engagement within adaptive UI to deliver content that accounts for the user and the environment where the interface is utilized similar to results found in Hussain's paper on "context-aware user interfaces" [15]. This conversation focuses on providing functionally unique/personal engagements with AI software in consideration with internal and external forces that may disrupt one's usability with a system (i.e. noisy environments, disabilities, location, platforms, connectivity, goals and tasks, etc.) [6, 9, 8, 15].

Key terms in multimodal studies can be HCI, personalized user interface, adaptive user interface, UX, UI, and AI. Similarly technical communication shares most of those terms with the addition of intelligent content, usability, content delivery [1, 2, 3], micro-content [4], and user engagement. I only limited my robotics study to artificial intelligence, HOTL and HITL [6], human-robot interaction [6, 8], human-robot communication, and Soldier Robot Teams (SRTs) [9]. The theories of human-robot interaction paved the groundwork for visualizing the reactive elements which help an AI and human engage to a point where the human-device paradigm blurs. While there are still challenges educating AI to be more engaging, the limitations of these machines helped inform me of the needs regarding TC's participation to utilize AI as a force of content delivery via UI design.

Methods

My own research into robotics and AI dynamics with respect to human engagement was limited so I started review the *IEEE Systems, Man, and Cybernetics Journal* to understand this unique research. I focused my efforts into discussions on the man-machine paradigm within the HOTL and HITL systems [5, 6, 7]. These informed me of theoretical principles of engagement and practical limitations within AI in the cybernetics community. After that I moved into HCI studies through *AI Magazine* where sociological studies of how people engage with computers elaborated on research of AI and robots engaging with humans [8]. HCI was able to point to the failures and successes of AI through empirical studies that measured usability, expectations, and first impressions when humans and AI engaged with each other. I shifted my focus into the *Journal of Multimodal User Interfaces* where exploratory experiments with AI resulted in data-driven studies of UI engagement [9, 10] and proposals for AI in UI to improve UX through increased usability [15]. Additionally, I was given a special issue of STC's *Intercom* which delved into the future of technical communication concerning content engagement with an AI system [3] and intelligent content delivery [1 ,2]. Finally, I looked at blogs from UX practitioners [12] and news article that dealt with AI working its way into interface design to interact with larger audiences in the wild [13, 14]. While most news stories talked about the benefits of AI, I found a healthy dose of skepticism from AI practitioners who talked about the negative possibilities of AI [8, 11] as possibly unpredictable elements that "have yet to be fully understood by their designers" [11].

Many articles address the need for more longitudinal study of AI interface engagements in empirical study. This urge to make more lengthy research concerns the lack of exposure most people have with more advanced AI systems that have gained more traction in the past five years. Though HCI has a dependable amount of research, I do wish I could have found some more longitudinal studies to cement my work. I do also wish I found more TC practitioners who wrote about AI in UI as much as other professions did. I want to make a clear understanding that in TC our use of clarity of rhetoric and aesthetic predispositions concerns multiple fields of study where the end-user experience is tantamount and so by looking into other fields, I want to connect our shared goals by supplementing TC practices in the AI field. I do feel my literature review was thorough and diverse enough to engage with a complex topic that is not my undergraduate study whilst recognizing its rising significance to shifting methods of communication.

Results

Much of my research characterizes AI as limited in its recognition and responsiveness towards visual and 3-D mapping [6]. Additionally, there was an understanding that AI technology would not be able to respond well to gesture controls as a method of human-robot teams [9]. In such studies preferences of multi-modal interactions often fell onto "verbal communication" for it "natural inclinations to completing tasks" [9]. However, the largest question I had to address was why TC's were not involving their research into this growing field. While reasons of "disappearing AI and the smallness of infinity" [8] hindered AI development in UI, studies have shown that AI controlled through a UI can support UX and end-user engagement [9, 10, 15]. Short term studies have shown AI's effectiveness within UI to adapt to users which augments usability with the software. The preference for GUI or VUI depends on user needs and one's

environment; however, empirical data shows that VUI can be just as effective as GUI to promote user engagement; even the combination of both interfaces engages with the user without feeling cumbersome [9]. The through-line for these AI studies all talk about the development of adaptive UI that, after some tutorials, can promote end-user engagement and functionality.

TCs in academia should retain humanities and audience analysis to understand how to build UI that can anticipate user needs [1, 3]. Additionally my focus of research, while outside of technical communication, hopes to place a TCs UX perspective in focusing AI user engagement. Academics may want to take further notice into multimodal studies with AI to enhance intelligent content delivery and user engagement. If academia wishes to further define our field with this growing technology it is important that we can contextualize its limits and utility to augment our communication with users. It is a weighty subject for experts, so it would be prudent for academics to isolate research on how to best curb AI's more erratic tendencies into a more transparent UI whereby user-feedback can be observed, measured, analyzed, and acted on in a rhetorically persuasive manner.

Technical communication will have to engage with CS professionals to understand how to best utilize this system in the best possible rhetorical manner. Therefore, it is incumbent on TC to, at least, conduct more study on the functionality this new technology has to offer towards assisting end-users. Our experience in UI design for audiences can improve as AI gathers more user information and evolves to complete tasks and promote ease-of-use for customers. The advancement of this technology demands our involvement if TC wishes to further spread its influence of effective communicable content delivery to clients. What makes this more important is the eventuality of AI in our lives, and so it would be inevitable that studies and practical longitudinal research is conducted through AI with our involvement in UI design and tailoring the UX to suit customers intuitively.

Conclusion

Our profession is not dying, but it isn't adopting new technology quick enough. While academia should ground itself in the humanities, there is a justifiable prudence for TC's involvement in AI. Our experience understanding users and simplifying complex scenarios gives us an edge in creating UI and tutorials for AI systems in the present and the future.

I believe there is more work to be done with AI. Additionally I feel that AR and VR will involve our own hands-on approach to interface design. While we are not sure how fast AI will grow, or if the capacity of Moore's Law will still hold true past quantum computing, we are sure that AI has eventual involvement in our lives for intelligent content delivery and UX enhancement. I would propose that additional research into UI design is needed from more TC practitioner sources (blogs) and Multimodal studies on HITL systems of control with AI technology. Self-driving cars and AI seem to be buzzwords of future tech and further study into their unique UI will be much more intricate, and possibly more opportunistic, for TC involvement with AI.

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