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Usability of voice-activated interfaces: A comprehensive literature review

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User interaction designing has been changed drastically in the recent past. Cutting edge technologies have enabled users to interact with digital products in more natural ways. For example, Natural Language Processing (NLP) and speech recognition technologies have revolutionized the user interaction experience. As a branch of Artificial Intelligence (AI), NLP introduces a computer-human interface where linguistic phenomena act as User Interface (UI) controls for software applications. As a result, most of the modern smart devices such as smartphones, smart speakers and smart home systems are equipped with voice interfaces. Natural language and voice interfaces are especially beneficial for elderly users and users having disabilities because they might not be able to use conventional user interfaces such as Graphical User Interfaces (GUI) and Command-Line Interfaces (CLI). However, the percentage of usage of elderly users is very low when compared to all users, and in numbers as well, approximating to about 20.1%. Moreover, this technology is not widely used in Sri Lanka in comparison to European countries. In this study, we systematically review previous research studies with two main objectives. First, exploring the strengths, weaknesses and vulnerabilities of the existing voice-activated interfaces. Second, analysing and summarizing the usability of four popular Voice Assistants (VA) namely Alexa, Siri, Cortana and Google Assistant. As the methodology, we selected research papers for this systematic review using keyword-based clustering and we obtained mainly four clusters namely usability, voice interface, methods, appliances and machine learning. We then extracted keywords from the abstracts of published papers in top ranked conferences. Further, we chose research papers using their references. Our investigation revealed that, though we are in a technological era, there are a number of common weaknesses and issues in VUIs, such as lack of understanding of voices other than the frequently used voices, incorrect capture of non-English words such as names of the cities, and commands have to be repeated to accomplish a certain task. Moreover, the main vulnerabilities identified are privacy and security issues with voice-activated interfaces. For example, smart voice-enabled devices record everything, including background noises may even sometimes violate a person's privacy. Furthermore, we identified that the above mentioned widely used smart VAs support more than 20 languages, on average. Then we summarized the usage of popular voice interfaces and we found that Apple Siri is the most popular and most accurate VA while Amazon Alexa is the least popular. Apart from that, according to the previous paper reviews, Google Assistant gives the most natural responses. The study will beneficial for the researchers who try to solve issues and try to improve existing features of voice-activated interfaces.

Keywords: Natural Language Processing, Usability, User experience, Voice user interface