

Fundamental Concepts of Human-Computer Interaction and Human-Centred Design: A Case Study Based on Apple Siri

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Abstract

Aim: The aim of the article is to present key issues in Human-Computer Interaction and Human-Centred Design, along with their actual reflection in the environment around us, based on the example of Siri software.

Methodology: Literature review, case study analysis, review of the research on the selected case study.

Results: In the article fundamental concepts of Human-Computer Interaction and Human-Centred Design are explained. HCI is defined as an interaction between human and computer, which can occur in a variety of ways, with the use of many electronic devices and 21st century technological possibilities. It is important that the interaction between the devices and its user is intuitive and tailored to human needs. The field that focuses on this issue is HCD. It puts people and their needs in the centre and ensures that the designed products serve humans. In order to present an example of human-computer interaction, the Siri software is described and its sample functionalities are listed. The article also includes the results of two studies on this software. The first one shows which functionalities are preferred by users, while the second one shows a high level of user satisfaction after using the Siri software.

Implications and recommendations: Analysing other types of human-computer interaction.

Originality/value: The article presents the basic knowledge about Human-Computer Interaction and Human-Centred Design. It also covers practical issues: stages of HCD and its basic principles. The article presents a study case of Apple's voice assistant Siri. Based on research the article provides answer the questions: what functionalities in the Siri assistant do users use most often and what is their satisfaction with using this tool.

Keywords: Human-Computer Interaction (HCI), Human-Centred Design (HCD), Siri

1. Introduction

In today's world, people every day use computers and other electronic devices that use modern technology. In the past, technology relied on simple solutions such as mouse and keyboard. Nowadays, technology uses more advanced solutions such as speech recognition, touch or physical activity. In addition, as technology advances, the awareness of human centricity in the development of new devices is growing. This article discusses the issue of an interactions between user and Apple's intelligent voice assistant Siri.

The article presents crucial issues in the field of Human-Computer Interaction and Human-Centred Design, with real-life examples based on the example of voice assistant Siri. It also covers some practical issues. The authors will try to answer three questions:

1. What are the basic concepts and assumptions of human-computer interaction and human-centred design?
2. For what purposes are users most likely to use the Siri virtual voice assistant?
3. What is the level of user satisfaction with the Siri virtual voice assistant?

The article begins with an introduction outlining the purpose and research questions. This is followed by a presentation of the theoretical background, the research methodology, the results and the conclusions.

2. Theoretical Background

2.1. Human-Computer Interaction (HCI)

Human-Computer Interaction is a field of science that studies the relationship between humans and computers (Redakcja IDEACTO, 2022). Moreover, it tries to help discover or improve the technology that enables this relationship (Cioczek et al., 2021).

Since the 1980s computers have become more available for ordinary people. It was a revolution, because computers stopped to be used only for specialized, military and scientific activities. In the result of this action the user of these devices has changed and was named by Eason as the naive computer user. He defined it as "a person who is not an expert in computer technology but who uses a computer system to assist him in the performance of a task" (Eason, 1976, p. 3). Such users assessed the programme based on how well it met their individual needs. In addition, they wanted to minimise the time of learning how computer system works and effort in using it (Eason, 1976).

HCI was presented for the first time in detail in 1982 during the conference "Human Factors in Computing Systems" in Gaithersburg. One of the first books in this area was Shneiderman's *Software Psychology* (1980). In the 1980s many articles on HCI were published, but in various fields of science, for example: management, psychology or systems engineering (Lazar et al., 2017).

HCI draws from many different areas of science such as for example: psychology, cognitive science, ergonomics, sociology, engineering, business, graphic design and computer science (Ghaoui, 2006).

From the perspective of social sciences and humanities, HCI examines cognitive and behavioural processes of users, while they are interacting with electronic device or another user via technology. Designers very often use metaphor of interpersonal communication to facilitate natural and seamless communication. The aim of using this metaphor is to gain information about designing computers and related to them interface (Waddell et al., 2015).

HCI is uncovering what rules a human is guided by to communicate with computer. Moreover, it wants to reinvent creating interface to increase usability and user experience (Waddell et al., 2015). HCI is designing, analysing and improving the interaction between computer and human to provide users with productive, efficient, enjoyable and safe working with the system (Sikorski, 2010).

Human-computer interaction research aims to improve the quality of computer use and create a more intuitive interface, therefore users can feel pleasure when using the product. What is more, interactive interface provides deeper, more consistent and lasting longer user experience (Redakcja IDEACTO, 2022). It is essential to remember about such issues as: accessibility, ethics, and inclusivity. Interaction between human and computer should be not only technologically innovative, but also socially responsible (Boubaker, 2023).

2.2. Human-Centred Design (HCD)

Human-Centred Design is one of the problem-solving techniques. In this field a human is the most important, which results in the creation of products and services tailored to client needs. During human-centred designing people's problems, needs and preferences are in the first place. A product designed with the use of HCD is more intuitive and accessible, and is likely to be more profitable. (Landry, 2020).

HCD is a way of creating in which human perspectives are always taken into consideration (Kamzol, 2020). It is essential for designers to stay grounded in people's lives, knowledge and experience, because such attitude leads to meeting the human's needs. IDEO shared in their book *The Field Guide to Human-Centered Design* their seven mindsets: "Empathy, Optimism, Iteration, Creative Confidence, Making, Embracing Ambiguity, and Learning from Failure" (IDEO, 2015).

Norman (2018) in video published on YouTube listed the following basic principles of Human-Centered Design:

1. Focusing upon the people. It is crucial to include needs of all users who are going to use the end product.
2. Solving real problems. It is essential to focus on identification and solving the real cause of the problem, not symptoms of the problem. The clue is to find the roots of the problem.
3. Everything is a system. It is important to look at the problem as a whole and remembering that different parts of system interact.
4. Making prototypes. It is hard to make perfect product on the first try, because human needs are complicated. It is worth to create and test prototypes to improve the product.

HCD is a process which has evaluated since the moment it was created. Initially HCD was used to designing everyday objects. Nowadays, it is used in various areas, such as e.g. services, and business modelling. The process of designing can be divided into stages. These stages do not have to be performed linearly (Roś, 2022). In this article two examples of division into stages will be presented.

Example 1

- Empathise – which encourages designers to identify with users. At this stage questions such as: "what user is doing and why, not only on physical level, but also emotional", are asked. What is more, problems are diagnosed, and solutions are found.
- Defining the problem – it means that designers focus on deep analysis of the problem.
- Generating ideas – it is realising with the help of different tools, such as Design Sprint.

- Prototyping – as a result, interaction with users is made.
- Testing – thanks to this stage designers could find out and gather feedback from users about their user experience. Designers analyse future features of product on the basis of what users said (Roś, 2022).

Example 2

The second division, presented by IDEO, mentioned three stages of the process: Inspiration, Ideation and Implementation. Completing each phase gives a chance to emphasise who it is created for (IDEO, 2015).

- Inspiration – it is observing people, gaining from them information about their needs and desires. Designers have to be creative and attentive in this phase. Such methods as interview, immersion, resource flow can be of help.
- Ideation – during this phase designers use information from the inspiration phase. It is focusing on generating ideas, specifying the possibilities of designing, making prototypes and gaining feedback. It ends when final version meets the client's needs. It can be useful to create frameworks, brainstorm, determine what to create as a prototype.
- Implementation – putting into practice what came up in the previous stage. Refine the model, if necessary, focus on building business relationship, defining success, keeping iterations monitoring and evaluation (IDEO, 2015).

HCD has changed designing. The changes observed include greater innovation in engineering design, productivity, quality, acceptance of the final product, reduced error rate and minimised development costs (Zoltowski et al., 2013).

Human-Centred Design prioritises clients and significant stakeholders. It is essential to understand the relations between these two groups. During designing the most relevant issue is the cooperation between end users, stakeholders and service providers. The aim of such collaboration is creating a solution which would satisfy all people involved in the process.

3. Methodology

According to Apanowicz (2002, p. 67), each document that reflects ideas, views, missions, achievements or proposals can be considered the subject of research, as it enables to recreate the actual activity or state of the analysed organisational structure.

The work began with a review of the literature available through Google Scholar and Google Books. Additionally, various online sources were utilised, including blogs, websites, and videos posted on the YouTube platform. The following sample queries were asked: "HCD", "HCI", "Human Computer Interaction", and "Human Computer design". The last two queries were used in Polish and English. These sources were analysed to gain theoretical and practical knowledge, as well as key issues in the form of definitions.

The topics were presented in detail using a case study analysis of Apple's Siri. Historical aspects and examples of use were presented. This was formulated based on information from the manufacturer's website and the Britannica website. In addition, the authors tested selected functionalities on physical Apple hardware (iPhone 14 plus with iOS 18.3) on which Siri was installed.

The culmination of the work involved a review of the research available on the selected case study. The studies were obtained from Statista, a platform specializing in data visualisation and collection. The phrases typed into the search engine were directly related to the Apple's Siri software. The selected studies focused on the percentage of usage of specific Siri software features and user satisfaction levels. The results of the first survey helped to illustrate which functions are most frequently used with the Apple voice assistant Siri. The implementation of these functions is an example of computer-human interaction requiring interaction

with the Siri software to execute a command given by the user. The results of the second survey allowed us to assess whether the software was created with humans in mind, they reflected the level of satisfaction of voice assistant Siri.

4. Findings

Today, we can find numerous examples of human-computer interaction. One of the available methods of interacting with devices is through voice communication. A representative of this solution is the software known as Apple Siri. It is an intelligent personal assistant that enables communication with a device via voice commands. Siri is integrated into the software of Apple devices such as the iPhone, iPad, AirPods, Apple Watch, HomePod, Mac, Apple TV, and Apple CarPlay (*Używanie funkcji Siri...*, 2024).

Users were first introduced to Siri in October 2011, during the launch of the iPhone 4S, though its origins trace back to 2003. Siri was the result of collaboration between Defense Advanced Research Projects Agency (DARPA) and the U.S. Department of Defense, which founded Cognitive Assistant that Learns and Organizes Project (CALO). The project was led by the non-profit organisation Stanford Research Institute International (SRI), utilising technology provided by the software company Nuance Communications. In 2007, researchers from SRI founded a startup under the now-familiar name Siri. A few years later, in 2010, Siri debuted as an app on the App Store, and in 2011, it was acquired by Apple for over \$200 million (McDonough, 2024).

Originally, Siri offered three English accents: British, American, and Australian. Interestingly, Susan Bennett, an American voice actor at the time, was unaware that the phrases she recorded would be used in Siri's software. The following years saw continuous development and updates to the software. In 2014, one of the key features that we still use today was introduced: the ability to activate Siri with the command "Hey, Siri". Siri operates using a speech synthesizer and a speech recognition feature that employs a deep neural network to identify the user's voice and listen for the phrase "Hey, Siri".

The process of executing a command begins with converting it into text and sending it to Apple's servers. There, Siri uses natural language processing to correctly interpret and carry out the task (McDonough, 2024).

Currently, Siri can be activated via voice commands, such as "Hey, Siri" or simply "Siri" as well as through specific button combinations. Once activated, Siri processes the command and provides a response, either as a voice message or by performing the requested action. Siri supports a wide range of areas, including calls and text messages, knowledge and answers, smart home control, and navigation and maps.

Examples of commands supported by Siri include (*Siri*, n.d.):

- "Siri, text Josh, 'How do you feel about sushi tonight?'"
- "Hey Siri, answer the phone."
- "Hey Siri, FaceTime Family group chat."
- "Hey Siri, what can I ask you?"
- "Siri, what's 20% of \$184?"
- "Siri, what's tomorrow's forecast for Warsaw?"
- "Hey Siri, arm the security system." (SmartHome)
- "Siri, turn on the living room TV."
- "Hey Siri, find a gas station."
- "Hey Siri, what song is this?"

In January 2019, a study was conducted in the United States with a group of 286 respondents aged 18-64. Its goal was to identify the most commonly used features of Siri. The most frequent response,

chosen by 39% of the participants, was using Siri for making calls. The next most common response, selected by 34%, was conducting searches (e.g., in Google), while checking the weather forecast was mentioned by 33%. Other popular responses included playing music or the radio (30%), setting reminders (17%), writing e-mails and messages (16%), and obtaining sports news (16%). All responses are presented in Fig. 1. These results display how often users make particular interactions with Siri. Additionally, it might be stated that the most frequently used functions are the easiest and users want the results very fast. These results do not need to be analysed in detail, as, for example, when receiving weather forecasts.

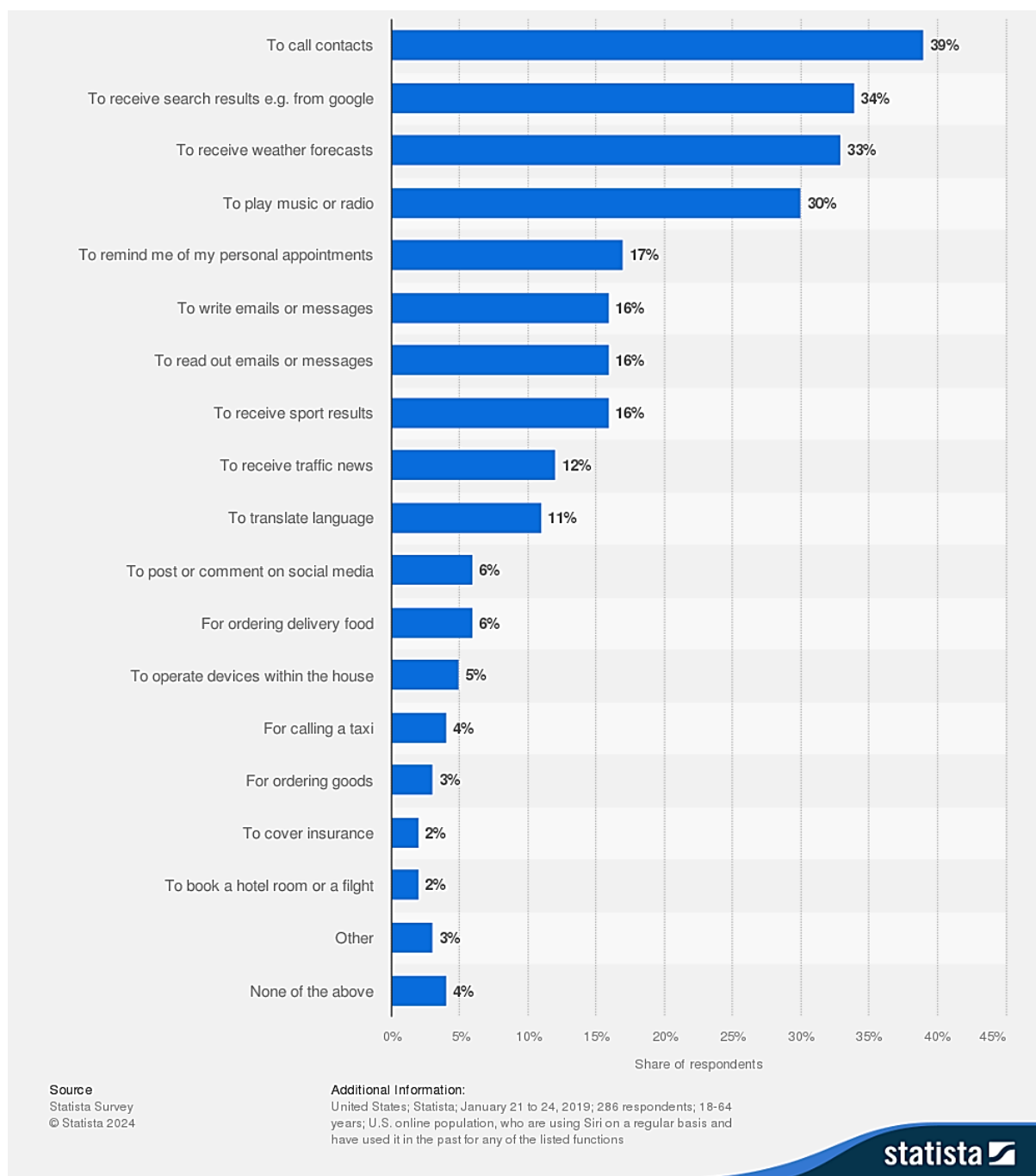


Fig. 1. Which of these functions of Siri do you use on a regular basis?

Source: (Statista, 2019b).

In 2019, a study on satisfaction with Siri's functionalities was also conducted in the United States, involving 432 respondents aged 18-64. Figure 2 displays the results of this study. It reveals that as many as 47% of respondents were very satisfied with the functionality of Apple's voice assistant. Slightly fewer, 39%, were somewhat satisfied, while 14% were somewhat or very dissatisfied. All responses are presented in Fig. 2. The outcomes show that users are satisfied with using voice assistant Siri. One may venture to say that Siri is a software which is human-centred design.

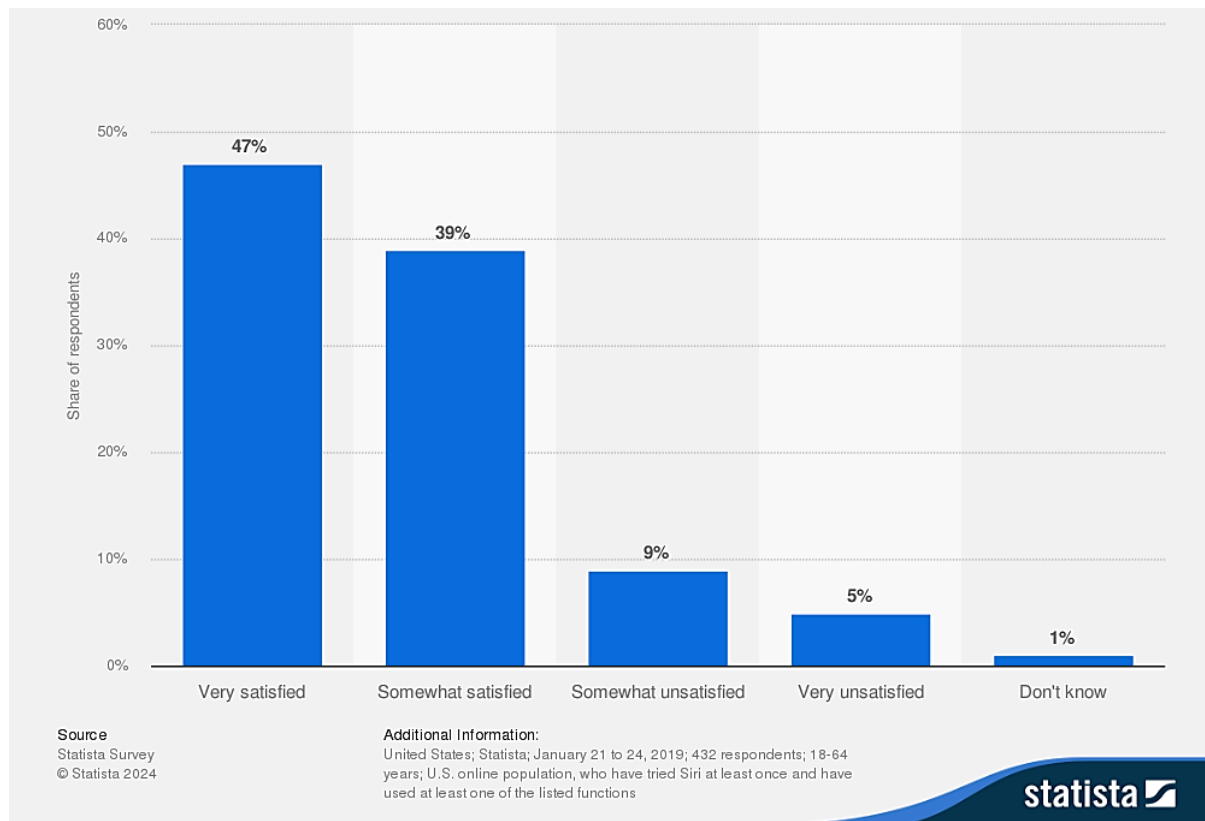


Fig. 2. How satisfied are you generally with the range of functions of Siri?

Source: (Statista, 2019a).

5. Conclusions

The article explains the concepts of Human-Computer Interaction and Human-Centred Designed. HCI is defined as human-computer interaction which can take place in a variety of ways, using a range of 21st century devices and technical capabilities. It is crucial that the interaction between the device and the user is intuitive and tailored to human needs. It puts the human being and his needs at the centre and makes sure that the products designed serve people.

The aim was to present crucial issues in the topic of Human-Computer Interaction and Human-Centred Design, with their real-life examples, based on the example of voice assistant Siri. It has been achieved by analysis of literature, internet sources, videos, and statistical sources.

To illustrate an example of human-computer interaction, the software Siri was described, along with the list of its example functionalities. The article also includes the results of two studies related to this software. The first study highlights the functionalities preferred by users, while the second demonstrates the high level of user satisfaction with the Siri software (see Table 1).

Table 1. Synthetic answers to the research questions

Research question	Answer
What are the basic concepts and assumptions of human-computer interaction and human-centred design?	HCI investigates the rules in communication between human and computer. It draws from different scientific files. HCI's aim is to ensure the best user's experience. HCD is one of the techniques of problem-solving and it is a way of designing that puts humans and their needs first.
For what purposes are users most likely to use the Siri virtual voice assistant?	Users use Siri mostly when they want to: call contacts, receive search results e.g. from Google, receive weather forecast or play music or radio and more.
What is the level of user satisfaction with the Siri virtual voice assistant?	User satisfaction of the Siri virtual voice assistant is very high. 86% percent of respondents were very satisfied or somewhat satisfied.

Source: own elaboration.

The article is an introduction to research in the area of human-computer interaction design placing voice interaction as an area of interest. However, this topic might be examined deeper and in the future different types of human-computer interaction might be analysed with practical examples. In addition, research could be conducted to see whether the design and development process for Siri's voice assistant is consistent with the way HCD principles work.

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Podstawy interakcji człowiek-komputer i projektowania zorientowanego na człowieka: Studium przypadku na przykładzie Apple Siri

Streszczenie

Cel: Celem artykułu jest przedstawienie kluczowych zagadnień na temat interakcji człowiek-komputer oraz projektowania zorientowanego na człowieka, wraz z ich rzeczywistym odzwierciedleniem w otaczającym nas środowisku na przykładzie oprogramowania Siri.

Metodyka: Przegląd literatury, analiza studium przypadku, przegląd przeprowadzonych badań na temat wybranego studium przypadku.

Wyniki: W artykule wyjaśnione zostały pojęcia Human-Computer Interaction oraz Human-Centred Designed. HCI definiujemy jako interakcję człowieka z komputerem, która może przebiegać w różny sposób, z wykorzystaniem wielu urządzeń i możliwości technicznych XXI w. Ważne jest, aby interakcja, która przebiega pomiędzy urządzeniem a użytkownikiem, była intuicyjna i dostosowana do potrzeb człowieka. Dziedziną koncentrującą się na tym jest HCD. Stawia ona człowieka i jego potrzeby w centrum oraz dba o to, by zaprojektowane produkty służyły człowiekowi. W celu przedstawienia przykładu interakcji człowiek-komputer zostało opisane oprogramowanie Siri oraz jego przykładowe funkcjonalności. W artykule zawarte zostały również wyniki dwóch badań dotyczących tego oprogramowania. Pierwsze z nich ukazuje funkcjonalności preferowane przez użytkowników, drugie natomiast przedstawia duży poziom satysfakcji użytkowników po korzystaniu z oprogramowania Siri.

Implikacje i rekomendacje: Przeprowadzenie analizy pozostałych rodzajów interakcji człowiek-komputer.

Oryginalność/wartość: Artykuł przedstawia podstawowe informacje na temat interakcji człowiek-komputer oraz projektowania zorientowanego na człowieka. Zawiera również kwestie praktyczne: etapy projektowania zorientowanego na człowieka oraz jego podstawowe zasady. W artykule zaprezentowany został przypadek użycia asystenta głosowego Siri. Na podstawie badań artykuł przedstawia odpowiedzi na pytania: z jakich funkcjonalności w asystencie Siri użytkownicy najczęściej korzystają oraz jaka jest ich satysfakcja z używania tego narzędzia.

Słowa kluczowe: interakcja człowiek-komputer (HCI), projektowanie zorientowane na człowieka (HCD), Siri