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Research on Media Presentation and Public Reaction to the First Health Digital Assistant in Croatia

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Abstract: This research paper investigates the perception, acceptance, and media presentation of the digital assistant *Andrija* in the healthcare sector during the COVID-19 pandemic. The research used combined methods that include analysis of the media presentation of the Andrija project and the public's reaction on Facebook, collection of public announcements on the Facebook social network, and their quantitative and qualitative analysis. The research sample consisted of 82 posts on Facebook that corresponded to the keywords "Andrija, digital assistant". The research results show that *Andrija* digital assistant played a key role in providing basic information about the COVID-19 pandemic and supporting the public in making informed decisions. The analysis of the media presentation of the *Andrija* project on Facebook revealed a diversity in the size of the posts, with an emphasis on image/video material and the presence of links to official websites. Also, *Andrija* chatbot was generally well received, with a high number of "Like" reactions and emotional connection expressed through "Love" reactions on analyzed Facebook posts. However, there are variations in user perception. Examination of the correlation between the size of the post (number of words) and reactions on Facebook posts did not show a statistically significant correlation between the size of the post and the total number of quick reactions, but a statistically significant positive correlation was found between the size of the post and the number of "Like" reactions.

Keywords: Health digital assistant, Andrija, Facebook, Media presentation, Crisis communication

Introduction

In the last few years, digital assistants and chatbots have become ubiquitous in our daily lives. Their application in various sectors, including healthcare, opens new opportunities for providing services and improving the user experience. Chatbots have the potential to revolutionize healthcare by providing patients with 24/7 access to information and support, assisting healthcare providers with administrative tasks, and improving patient engagement and outcomes (Božić, 2023).

Chatbots can also be used to triage patients who have certain symptoms, as well as provide additional consultative support after a clinical encounter. This functionality is particularly important in the context of the global shortage of health workers, which is estimated to be around 18 million by 2030 (Parmar et al., 2022). By using chatbots for triage, healthcare systems can reduce the burden on healthcare providers and prioritize patients most in need of emergency medical care.

A 2020 study identified 78 commercially available health bot applications in 33 countries and provided a comprehensive overview of these applications (Parmar et al., 2022). The results showed that most applications are focused on patients and on primary health care and mental health. According to a study by Amiri & Karahanna, which analyzed 61 chatbots used in more than 30 countries, chatbots provide complementary

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functionality that increases the activities of public health workers in responses related to public health; addressing capacity constraints, they go beyond the demands of social distancing and misinformation (Amiri & Karahanna, 2022).

The COVID-19 pandemic presented a global challenge that required the rapid dissemination of information, symptom monitoring, and mental health support for individuals around the world. In this context, chatbots have emerged as a useful tool for providing quick information and support to users. Organizations such as the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) have recognized the importance of new communication mechanisms in responding to citizen requests related to COVID-19. The implementation of chatbots by many countries as a means of monitoring symptoms, providing testing instructions, informing about safety measures, and providing general advice on disease prevention has proven extremely useful in situations of high demand for health services and limited resources. In the study by Amer et al. (2021), a proposed chatbot system was used that used a pre-trained Google BERT Language model along with a test classification and categorization technique based on word meaning. The results showed that such a system can effectively manage a large number of citizen requests during a pandemic, ensuring credible sources of information to prevent the spread of misinformation (Amer et al., 2021).

Chatbots must be effectively designed to prevent misinformation, and to help in symptom detection, encourage behaviors that reduce the risk of infection, and reduce the burden on the mental health of individuals facing the pandemic (Miner et al., 2020). Medical and public health professionals must also be involved in informing what chatbots are saying and how they are saying it. Translating medical information into public advice requires expertise and judgment to avoid unintended consequences. Reliability of evidence-based information, coordination with regional authorities and connecting users to reliable sources of information are also key aspects that chatbots should provide (Miner et al., 2020). Chin et al. (2023) investigated user communication with the chatbot SimSim on the basis of 19,782 chats in five culturally diverse countries and identified 18 new themes, which can be categorized into the following 5 overarching themes: "Questions about COVID-19 posed to the chatbot" (30 .6%), "Preventive behavior" (25.3%), "The outbreak of COVID-19" (16.4%), "Physical and psychological impact of COVID-19" (16.0%) and "People and life in pandemic" (11.7%). A study found that users searched for health-related information and shared emotional messages with the chatbot, indicating the potential use of chatbots to provide accurate health information and emotional support during a global health crisis (Chin et al, 2023).

In the context of the COVID-19 pandemic, digital technology, including mobile apps and chatbots, has the potential to revolutionize mental health care. However, it is important that the implementation of these technologies is based on rigorous research and ethical principles to ensure safety, efficacy, and fairness for patients (Torous et al., 2021). In addition to the direct role and application in healthcare, chatbots can also have an indirect role in healthcare through the media. Maniou & Veglis (2020) investigated the use of chatbots on media platforms during crisis situations such as the COVID-19 pandemic, and at the same time highlights the advantages of implementing chatbots on news platforms during a crisis situation when the audience's needs for information grow rapidly.

This research aims to fill this knowledge gap and provide insight into the perception and acceptance of digital assistants in healthcare. By reviewing previous research, which investigates the perception and acceptance of chatbots for COVID-19 among different populations and contexts, the goal was to identify the key factors that influence the success of the implementation of such technologies. The aim of this research is to expand the previous research by Petričević and Mustić on the design and media presentation of the digital assistant *Andrija* through the analysis of the media presentation of the Andrija project and the public's reactions on Facebook during the COVID-19 pandemic. Also, paper analyzes the attitudes, perception, and acceptance of digital assistants in healthcare, identifies key aspects that influenced user acceptance or uncertainty, and provides guidelines for improving the design, media strategy and adoption of digital assistants in the healthcare sector. By studying the comments and reactions of users on *Andrija*'s official Facebook page, the research will provide insight into the first impressions of the digital assistant, the main points of interest of users and their feedback.

Evaluation of Chatbots: Literature Overview

Evaluation of chatbots plays a key role in their successful application. An important factor in human-computer communication and interaction is design, which can significantly affect the reception of a message and the ways in which a person will act after receiving the message. Design refers to the aesthetic appearance, organization, and presentation of information, as well as the functionality of the interface between users and computer

systems. The way information is presented, as well as the user's experience interacting with the computer system, can shape the user's understanding and interpretation of the message. In the context of communication, design plays a key role in the successful transmission of messages. A good design should be intuitive and easy to use, allowing users to easily navigate through the computer system and perform the desired tasks. These include well-organized menus, logically arranged controls, and clear instructions. These basic guidelines of good design are also applicable to chatbots. Visual communication represents a complex and continuous communication process that takes place between the author (creator) as the sender of the message and the recipient of the message. The author creates visual communication with the goal of making the recipient believe that the message has a socially accepted meaning (Plenković & Mustić, 2020). However, in the modern digital age, chatbots have become ubiquitous in interacting with users, providing various services and information. This chapter analyzes several key aspects of the application and design of chatbots in the contemporary context.

Saeidnia et al. (2021) studied the HealthBuddy+ application developed by UNICEF ECARO and WHO/Europe. The app received positive ratings for system status visibility, system-to-real-world match, consistency and standards, and evidence-based content. However, vulnerabilities were identified in the areas of error prevention and flexibility. The authors suggest that heuristic assessment can be used for rapid assessment of mobile health applications, which is especially important during pandemics when a rapid response is required (Saeidnia et al. 2021).

A 2021 review (Höhn & Bongard-Blanchy, 2021) analyzed chatbots for COVID-19 and their compliance with design heuristics. The results showed that most chatbots scored well in terms of system status visibility, real-world match, consistency and standards, and aesthetic and minimalist design. However, chatbots scored poorly on user control and freedom, recognition instead of recall, flexibility, and efficiency of use, understanding of context, and ability to manage interactions.

Recent research has identified key factors influencing the adoption and engagement of chatbots for COVID-19. These factors include content, trust, digital capability, and acceptability. The study concludes that "there is a need for more comprehensive and routine reporting on factors influencing adoption and engagement“ and highlights the potential of chatbots to disseminate high-quality information during a crisis, but also highlights the importance of understanding user experiences and preferences to ensure their effectiveness (White et al., 2022).

Espinoza et al. (2020) emphasize the importance of user-centered design and decision-making about goals, users, actions, and workflows in the development and implementation of chatbots for healthcare institutions. They recommend starting with user experience and process mapping for users and service providers who will interact with the chatbot. The authors also suggest institutions to clearly define what a chatbot can and cannot offer and identify the tools available to the chatbot to achieve the goal. In addition, they emphasize the importance of considering data governance, legal, and compliance issues, particularly when collecting protected health information/personal data (Espinoza et al., 2020).

The results of a study conducted on 371 participants, which aimed to understand people's reactions to COVID-19 screening chatbots, showed that if the perception of the capabilities of an agent, human or chatbot is the same, users do not view chatbots any differently or more positively than human agents. The primary factor driving the perception of capability was user trust. Therefore, it is important to proactively inform users about chatbot capabilities; that is, users should understand that chatbots use the same up-to-date knowledge base and follow the same set of validation protocols as human agents (Dennis et al., 2020).

Research which studied *Chasey*, a character-based COVID-19 chatbot, scored well in terms of usability and user experience. The chatbot provided users with various information about the disease COVID-19, such as tracking cases by country, giving advice, answering frequently asked questions, and checking symptoms. The chatbot had two characters (informal and formal) that the user could freely switch during the conversation, and the participants found that all the features of COVID-19 were useful. Most participants preferred the informal character over the formal character, but participants had mixed feelings about which character they trusted the most (El Hefny et al., 2021).

In an example of the effectiveness of chatbots in promoting compliance with social distancing guidelines during the COVID-19 pandemic, a study found that chatbots reminding individuals of their non-compliance with social distancing guidelines can induce guilt and increase adherence; and in this way, chatbots can be a cost-effective alternative to traditional approaches to encourage compliance. At the same time, the study says that the

effectiveness of this technique depends on the level of anthropomorphism of the chatbot, whereby human-like chatbots are more effective than machine-like ones (Kim & Ryoo, 2022).

In the context of the development of the chatbot itself, Bahja et al. (2020) talk about a user-friendly framework for designing and developing educational chatbots and emphasizes the importance of considering user needs and preferences in the design process. The pandemic prompted the development of a *Smart Ubiquitous Chatbot for COVID-19 Assistance* with a deep learning sentiment analysis model during and after quarantine. A chatbot was designed to collect information from users to understand their situation and provide actions accordingly. The study also included a sentiment analysis model based on an LSTM neural network to detect depression in user-supplied texts during an ongoing discussion (Ouerhani et al., 2020). Abdul-Kader & Woods (2015) concluded that creating a perfect chatbot is very difficult because it requires a very large database and it should give reasonable answers to all interactions.

A study conducted in Romania (Iancu & Iancu, 2023) investigated the perception of chatbots for COVID-19 among middle-aged and older adults. The results showed that perceived usefulness and subjective norms were the main predictors of behavioral intention to use chatbots, while age and gender did not significantly influence their perception. A further study conducted in Brazil (Chagas et al., 2023) evaluated user experience with a COVID-19 chatbot designed by a telehealth service. The results showed that the chatbot was generally well received by users, but opportunities for improvement were identified in terms of providing more practical guidance and updating information.

A study conducted in Southeast China during the Omicron wave of COVID-19 (Shan et al., 2022) investigated user experience and satisfaction with health chatbots among young people aged 17–35 years. The results showed a positive user experience and high satisfaction with healthcare chatbots, with personalized responses and convenience being key factors influencing their use. This study also developed a new user experience and satisfaction assessment model for research.

Media Presentation of Digital Assistants

Digitization of the media brings numerous changes in the way the media function, with a special emphasis on adaptation to technological innovations (Plenković & Mustić, 2011). Social media play a key role in communication during crisis situations such as a pandemic and can be a valuable tool for disseminating information and building public relations.

Media presentation of chatbots plays a key role in popularizing their use. In the modern digital age, where information is available in abundance, the media presentation of chatbots provides an opportunity to spread awareness of their presence and benefits among a wider range of users. Through adequate media presentation, chatbots can reach a larger number of people and create interest in their use. A strategic approach to the media presentation of chatbots can help break down prejudices and resistance to the use of such technology. Through objective and reliable media sources, it is possible to highlight the security, privacy, and reliability of chatbots. Informing users about how chatbots protect private data, use advanced technologies such as artificial intelligence and machine learning, and provide quality services can reduce reservations and increase user confidence in their use.

Research on the official Facebook pages of municipalities and emergency service agencies during three terrorist attacks in Berlin, London and Stockholm showed that the presence of a picture or video in a post significantly increases the number of reactions, and that the length of the text negatively affects the number of reactions (Ross et al., 2018.). During the COVID-19 pandemic, the use of social media has increased significantly, and platforms such as WhatsApp, Facebook, Instagram, and Twitter have become vital for disseminating information about the disease (Sathish et al., 2020). However, research has also shown that social media can be a source of false information and misinformation, which can cause anxiety and fear in people, especially when it comes to vaccines (Ennab et al., 2022; Gabarron et al., 2021, p 463). Malecki et al. (2021) emphasize the need for clinicians and public health professionals to be proactive in shaping messages and addressing sources of fear, anxiety, and misinformation; while MacKay et al. emphasize the importance of crisis communication messages on social media to be transparent, empathetic, consistent, accurate and timely.

Analyzing public comments on social media can help organizations understand public reactions and adjust their communication strategies (Coombs, W. T., & Holladay, S. J., 2014). It is also important to point out that the analysis of public online discourse can provide insight into different emotions, ideologies, and attitudes of

people in crisis situations. This can help decision makers better understand public expectations and concerns and develop more effective policies and responses (Khanum & Shahid, 2021). The importance of using Facebook in crisis management as well as interactions in social networks was investigated by the authors of the study Ki & Nekmat, (2014) and found a significant relationship between the organization's involvement in two-way communication and the overall positivity of the audience's tone in reaction to organizational crisis resolution (Ki & Nekmat , 2014). "Facebook continues to lead as a source of news compared to other social media,..." and in the Croatian sample, the very high position of Facebook as a source of news can also be confirmed (Vozab & Peruško, 2021).

In short, the digitization of media, the use of social media, chatbots and other digital technologies and the analysis of public discourse on social media play an important role during pandemics and crisis situations. However, it is important to manage these tools properly to ensure accurate and relevant information, and to protect the mental health and well-being of the public.

Analysis of the media presentation and public reaction to the Croatian version of the health digital chatbot can provide *Andrija* with guidelines for further improvement of the design, media strategy and adoption of digital assistants in healthcare. Discovering the key aspects that contributed to user acceptance or uncertainty can help develop strategies that will drive further adoption and integration of digital assistants into healthcare systems.

The public's reaction to digital assistants, such as *Andrija*, can reveal the attitudes, perception and acceptance of such technologies in society. Studying the comments and reactions of users on *Andrija*'s official Facebook page can give us an insight into how this digital assistant was received, what were the main points of interest of users and what was their feedback. Analysis of the media presentation, public reaction and user feedback provide us with valuable insights for the further development and adoption of such technologies in the health sector.

Method

This research aims to study the perception and acceptance of the digital assistant *Andrija* in the healthcare sector during the COVID-19 pandemic. Content-wise, the research is divided into two basic parts. The introductory part of the research summarizes the results of the previous research by Petričević, S., & Mustić, D. (2023) which is the basis for further research. The previous research, dealt with the design and media presentation of the digital assistant itself and has provide us with an introductory context and contributed to a better interpretation of the results of this research. The main part of the research includes an analysis of the media presentation of the *Andrija* project and reactions, as well as public comments on Facebook.

Sample

For data collection, public announcements on the Facebook social network were accessed. The keywords "Andrija, digital assistant" was entered into the search engine were used for the search on Facebook. All public announcements that corresponded to the keywords and research topic were observed. The collected data were analyzed using a research matrix that includes the following variables: publication date, publication size (number of words), type of image material, existence of a link to official pages, number and type of reactions, number of shares and analysis of comments according to sentiment (positive, negative, neutral). The unit of analysis was one Facebook post. In the research of posts on Facebook that corresponded to the keywords "Andrija, digital assistant", we analyzed a total of 82 posts published in the period from April 13, 2020. until 27.4.2022.

Procedures

A combination of qualitative and quantitative methods was applied for data analysis. All collected data were analyzed using the Microsoft Excel program. Qualitative content analysis was applied to selected examples of comments to better understand user opinions. The quantitative analysis included descriptive statistics, including frequencies and means, to describe the basic characteristics of the data. Inferential statistics were also applied to check for statistically significant differences or trends. To analyze associations between variables, we used multivariate analyzes to explore potential correlations. The combination of the above methods enabled a deeper understanding of the perception and acceptance of Andrija's digital assistant in the health sector during the COVID-19 pandemic.

Ethics

Ethical guidelines were followed during the research. Special attention was paid to the protection of user privacy, and the authors adhered to ethical standards when collecting data on social media. For privacy protection purposes, personal names that are publicly available in the analyzed content were not used in the analysis.

Limitations of the Research

Limitations of this research include limited access to only public posts on Facebook and the possibility of bias in data collection due to the subjective choice of keywords. Also, it is important to note that the results of this research are based solely on the analysis of data from Facebook and do not include other platforms or communication channels.

Results and Discussion

The results of the first part of the research published by Petričević and Mustić (2023) provide an important context for the second part of the research. Those results indicate that Andrija, as a multipurpose chatbot, was focused on risk assessment and providing basic information about COVID-19. These results show that *Andrija* played a useful role in providing basic information about the pandemic and supporting the public in making informed decisions. Also, the research revealed that *Andrija* had limited functionality in disseminating information in a broader sense. The official presentation of the digital assistant *Andrija* was held on April 14th at the press conference of the Government of the Republic of Croatia, where the choice of the name Andrija was explained, but not the visual representation of the character of Andrija. In the presentation, it was stated that *Andrija* was named after Dr. Andrija Štampar, who established the fundamental principles of public health in Croatia that are applied throughout the world.

In the information dissemination category, the research identified seven subcategories, but *Andrija* supported only three of them, which indicates that his ability to disseminate information was not fully utilized (Table 1). This limitation may indicate potential flaws in the design or implementation of the chatbot. The most common combinations in multi-purpose chatbots were risk assessment and information dissemination, which was also demonstrated in *Andrija*'s case.

Table 1. Andrija chatbot cases and usage definitions

Use-case category and associated use cases	Use-case description	Benefits
Risk assessment	Triage users based on their Covid- 19 symptoms and exposure risk and recommend a course of action.	Social distancing, capacity expansion, efficient capacity utilization, prevent virus transmission
Surveillance	/	/
Information dissemination	Virus and vaccine education Misinformation/disinformation debunking Proactive misinformation/disinformation debunking Nonpharmaceutical interventions (NPI) promotion Virus transmission data reporting Available public resources awareness Encouragement of activities (other than NPIs) to fight the pandemic	
Post-Covid-19 eligibility screening	/	/
Distributed coordination	/	
Vaccine scheduler	/	/

Andrija was a multipurpose chatbot that was available on the WhatsApp platform (Table 2). It did not ask for additional information about the user except for saving the number in the directory, and he was presented as a man (Figure 1). However, *Andrija* was not integrated into a high-traffic platform, which could have improved his visibility. The results suggest that *Andrija* was focused on risk assessment and providing basic information about COVID-19 but had limited functionality in disseminating information.

Table 2. Design characteristics of chatbot Andrija

	Andrija
Multipurpose versus single purpose	multipurpose
Chatbot platform	WhatsApp
Anonymity	does not enquire additional user identifying information
Anthropomorphism	male
Interface design	text-based
Follow-up and recurring conversation	no follow-up option

Figure 1. Andrija (available at: https://vlada.gov.hr/vijesti/predstavljen-andrija-prvi-digitalni-asistent-u-borbi-protiv-koronavirusa/29226)

The research also analyzed official government communication channels, including the websites of the Government of the Republic of Croatia and the Ministry of Health. Only a few pages were found that mentioned *Andrija* on those websites. Media sources were also analyzed and several publications and articles about *Andrija* were found. Only 3 pages were found on the official website of the Government, while only 1 page mentioning *Andrija* was found on the website of the Ministry of Health. The number of pages that refer to or mention *Andrija* is relatively low. On the official website of the Government, there were no further announcements on the subject of *Andrija*, digital assistant, while on the official website andrija.ai in the section "Andrija - How I am developing" - there were a total of eight announcements from April 14, 2020 to September 14, 2020. The section of the official website "Andrija in the Media" records thirty-three (33) publications in the media, i.e. a link in the media with publication dates from April 13, 2020 to May 4, 2020, which suggests that *Andrija* attracted media attention and was the subject of interest during that time. *Andrija*'s media promotion was relatively modest. Although the chatbot attracted media attention for a certain period of time, the number of publications and articles related to *Andrija* was not large. These results serve as a starting point and provide an important context for the second part of the research, which will analyze media coverage on the Facebook social network and its impact on the perception of health chatbots among users and the general public.

In the main part of the research, we focused on the analysis of the media coverage of chatbot *Andrija* on the Facebook and its impact on the perception of users and the general public. The largest number of posts was recorded on 14/04/2020, which was the day of *Andrija*'s official presentation, with as many as 44 posts. The next most represented date was April 15, 2020. with 22 posts. The other dates had a smaller number of posts, with most of them having only one or two posts (Table 3).

Petričević and Mustić (2023) state that *Andrija* attracted media attention during the period from April 13, 2020 to May 4, 2020 with a total of 33 media announcements, which suggests that he was the subject of media interest during that time and that there was significant reporting on it. Both of these pieces of information indicate that *Andrija* attracted attention both on social networks (through the number of posts on Facebook) and in the media (through publications in the media).

Next, the posts themselves were analyzed. The size of the posts was analyzed by number of words. The results showed a diversity in the size of posts on the social network. The average post size is 78 words, but with high

variability (Sd=164.33). The post size range is 1407 words. It is important to note that four of the posts do not have any words, which may indicate image or other types of posts that do not rely on textual content.

Table 3. Total number of publications by day

Date	Total number of posts on Facebook about Andrija
13.4.2020	2
14.4.2020	44
15.4.2020	22
16.4.2020	3
17.4.2020	1
18.4.2020	1
20.4.2020	1
28.4.2020	1
1.5.2020	1
24.6.2020	2
1.7.2020	1
14.7.2020	1
22.7.2020	1
27.4.2022	1

The type of image/video material contained in the post was also analyzed (Table 5). The results showed that in 8 posts there were no attached picture or video material, which means that these posts were exclusively textual in nature, while the most posts (60 post) showed a picture of the digital assistant *Andrija*. From these results, it can be concluded that images of *Andrija*'s digital assistant have a higher prevalence in posts compared to other types of image/video material.

Table 4. Type of image / video material

Type of image / video material	Number of image/video material
There is no image / video material	8
Other image/video material	3
Picture / video of people who used the digital assistant Andrija	1
Picture / video of a politician	3
Picture of digital assistant Andrija	60
Video through the Andrija application	7
Grand total	82

Table 5. Activities of announcements about Andrija

Date	Number of posts	Number of fast reactions	Number of comments	Number of shares
13.4.2020	2	67	37	15
14.4.2020	44	2376	379	357
15.4.2020	22	825	172	41
16.4.2020	3	542	25	24
17.4.2020	1	454	27	30
18.4.2020	1	31	0	2
20.4.2020	1	45	0	1
28.4.2020	1	6	0	0
1.5.2020	1	12	2	0
24.6.2020	2	10	1	6
1.7.2020	1	4	0	1
14.7.2020	1	20	20	1
22.7.2020	1	10	1	1
27.4.2022	1	55	0	0

55 posts had a link to official websites related to *Andrija*, such as government or ministerial websites. Compared to the number of pages related to *Andrija*, these results suggest a greater visibility and spread of posts on the social network. This indicates the importance of social networks as a channel for sharing information and

promoting *Andrija* as a digital assistant of the Ministry of Health. Integrating links and information from social networks to official pages can increase the availability and reach of information and research results can be useful for planning future marketing strategies on social networks. Furthermore, we quantitatively analyzed data on the activity of posts about Andrija on Facebook on different dates (Table 5).

This data set provides information on the activity of posts about *Andrija* on Facebook on specific dates, and user interaction with posts related to *Andrija*, such as likes, comments and shares. The results show how many posts were dedicated to *Andrija* on each of the listed dates. For example, 14/04/2020, which is also the day of the chatbot's official presentation to the public, was the day with the largest number of posts (44) quick reactions (2376), comments (379) and shares (357), while some dates had only one post. The total number of quick reactions shows how many quick reactions (like likes, smileys, hearts, etc.) have been received on *Andrija*'s posts. The number of comments reveals how actively users participated in discussions and conversations about *Andrija*. The total number of shares of the post indicates how many times posts about *Andrija* were shared by Facebook users. Higher number of quick reactions, higher number of quick reactions; of comments and shares may indicate a greater interest or engagement of users towards those posts. Based on these results, one can gain insight into user engagement, the popularity of posts about *Andrija* and the spread of information about that content on Facebook. It is also possible to monitor activity trends over time and identify dates with greater or lesser interest in posts about *Andrija*.

An analysis of 82 posts on Facebook related to *Andrija*, the digital assistant, recorded a total of 4461 quick reactions (Table 6). Quick Reactions include "Like", "Love", "Support", "Ha-ha", "Wow", "Sad" and "Angry" emoticons that allow users to express their opinions or emotions about posts. This high number of quick reactions indicates that the posts about *Andrija* caused interest and user engagement on Facebook, which suggests that *Andrija* has attracted the attention of the audience and caused emotional reactions from users. Also, these results indicate a positive response to posts about *Andrija*, which indicates that the digital assistant was well received.

Table 6. Quick reactions types

	Like	Love	Support	Ha-ha	Wow	Sad	Angry
M	46,01	3,05	0,01	4,56	0,26	0,17	0,34
SE	9,71	1,17	0,01	1,16	0,07	0,05	0,09
Md	13,5	0	0	0	0	0	0
Mo	10	0	0	0	0	0	0
SD	88,01	10,61	0,11	10,48	0,6	0,44	0,86
Var	7745,75	112,51	0,01	109,76	0,37	0,19	0,75
Sum	3773	250	1	374	21	14	28

Based on the reactions to Facebook posts about *Andrija*, the following can be concluded about the acceptance of the digital assistant:

- The reaction "Like" has a high mean value (46.01) and a significant sum (3773), which indicates a positive acceptance of *Andrija*. A high number of "Like" reactions implies that *Andrija* has attracted the attention and interest of users.
- The reaction "Love" also has a large sum (250) and a mean value (3.05), which indicates an emotional connection and a positive attitude towards *Andrija*.
- Other reactions like "Support," "Wow," "Sad," and "Angry" have low mean values and smaller totals. This indicates that these reactions are relatively rare and less relevant in the context of Andrija's acceptance.
- The "Ha-ha" reaction also has a large sum (374) and a relatively high mean (4.56). However, the "Ha-ha" reaction can be interpreted in two ways: 1) as positive support, indicating the user's amusement or positive reaction to *Andrija*'s posts; and 2) as sarcasm, which may imply a reminder of a negative aspect or failure. Therefore, it is necessary to take into account the context and content of the posts in order to better understand the meaning and impact of "Ha-ha" reactions on *Andrija*'s acceptance.
- High values of standard deviation for reactions like "Like" (88.01) and "Ha-ha" (10.48) indicate great variability in users' perception and that users' opinions about *Andrija* are varied.

Positive reactions, such as "Like" and "Love", dominate user reactions. These reactions had a high mean value and a significant number, which indicates a positive acceptance of *Andrija*. On the other hand, negative or neutral reactions were less noticeable.

The results of the conducted research suggest that *Andrija*, as a digital assistant that provides information on the fight against Covid-19 and represents progress in technology, attracted attention and caused positive reactions from users on Facebook. However, it should be noted that these results assess only the quantitative aspect of reactions, while the qualitative aspects of acceptance could be better understood by analyzing the comments themselves.

Based on this, an analysis of the comments in the observed posts was carried out. All primary comments on the publication were analyzed and divided into three basic categories: comments with a positive connotation, comments with a negative connotation, and comments with a neutral connotation/comments unrelated to the topic of the publication (Table 7). The overall analysis of the results reveals that out of a total of 664 comments, 22.1% are positive comments, 32.2% are negative comments, and 45.7% are neutral comments or comments unrelated to the topic. In the context of positive/negative comments, we can conclude that in posts, negative comments are more frequent than positive ones.

Table 7. Data on comments

	Positive comments	Negative comments	Neutral comments /unrelated to the topic
Sum	147	214	303
Posts (N)	82	82	82

Analyzing the types of comments, we selected several examples from each type (Table 8).

Table 8. Examples of comments

Comment sentiment	Comment
Positive	"Andrija, ok. Modern." " Andrija, you are a great guy!" "Bravo! 👏🔝😁" "Bravo! Congratulations to the whole team! " " Wonderful. I'm looking forward. We need stories like this!"
Negative	"One of the biggest stupidities of our government " "... I don't want a guy...give me a woman… " "For people control… 😭😭😭😭 s***" "Quite primitive, I must admit, if compared to some other bots." " Thank you, but a computer epidemiologist cannot and should not replace a classical profession...." " Andrija, I hit my finger with a hammer, are those pains symptoms of corona??"
Neutral / unrelated to the topic	"...Andrija mine 🤭" " Andrija, what do you say about the new merge of cities and municipalities into 155 units?" " I am waiting for continued cooperation... Andrija 2.0 🤖" " How to win on a public tender? "

Analyzing the comments of users in the posts, some of which are shown in Table 8, one notices the mixed perception of chatbot *Andrija*. There are positive, negative and neutral comments that provide insight into users' attitudes and their reactions to using chatbots.

Positive comments emphasize the speed and efficiency of the chatbot compared to a phone call. Users express satisfaction and support for the chatbot, considering it an excellent tool. These positive comments provide confirmation that the chatbot has fulfilled its purpose in providing basic information about the pandemic and supporting users in making informed decisions.

Negative comments express the user's disappointment or dissatisfaction. Some users consider the chatbot frivolous, banal, or unintelligent, while others criticize the app's power or advertising. Also, criticisms is related to the design of the chatbot, the lack of a female name (character) or the perception of customer support. These negative comments point to the need to improve the chatbot to meet user expectations and respond to their needs. At the same time, given that our results showed that Andrija's image was the most represented in the posts, criticisms related to the design, or the perception of customer support can be useful guidelines for improving interaction and user experience.

Neutral comments refer to other topics or ask questions not directly related to the chatbot. They do not provide direct feedback about the chatbot or its shortcomings. Such comments can be useful for understanding other interests and needs of users, but do not provide concrete guidance for improving the chatbot.

It is important to note that the sample comments represent only a small sample of user opinions and do not reflect all possible perspectives. Comments are subjective and depend on the individual experience and expectations of the user. However, these comments can be useful for further improving the chatbot, including considering user suggestions, improving the design and efficiency of responses.

To assess the conformity of the dataset pertaining to the overall count of rapid reactions and post size to a normal distribution, the Kolmogorov-Smirnov (K-S) test was employed (Table 9). The outcomes of the K-S test revealed that the dataset does not adhere to a normal distribution. The K-S test statistic (D) obtained a value of .303, with a significance level of $p < .000$ for quick reactions and .317, with a significance level of $p < .000$ for post size (word count).

Table 9. Test statistics on count of quick reactions and post size (word count)

	Quick reactions	Post size (word count)
N	82	82
M	54.35	78.01
Md	16.5	40
Sd	101.61	164.33
Sk	3.06	6.83
Kt	9.39	54.03
D	.303	.317
p	< .000	< .000
r_s	.216	
p(2-tailed)	.051	

The quantity of quick reactions exhibited its highest peak during the initial phase of the observed period, coinciding with the media introduction of the chatbot, subsequently followed by a decline in reaction counts. In order to assess the relationship between the size of Facebook posts (measured by the number of words) and the total number of quick reactions, Spearman's rank correlation coefficient, a non-parametric test, was employed. The results of the Spearman's rank correlation test indicate that the correlation between the size of the post and the total number of quick reactions is not statistically significant ($r(80) = 0.22$, with a corresponding p-value of .05). This implies that the available statistical evidence does not support the presence of a meaningful relationship between these variables. However, there is a statistically significant correlation between the size of the post (number of words) and the number of "Like" reactions ($r(80) = .22$), with a corresponding p-value of .04. The result is significant at $p<.05$. We have to bear in mind that correlation does not imply causation. While a correlation between post length and the number of likes may exist, it does not necessarily mean that the length of posts directly causes the number of “Likes”.

In short, based on these results, it can be concluded that the size of the post (number of words) is not correlated with the total number of quick reactions, but there is a statistically significant positive correlation between the size of the post (number of words) and the number of "Like" reactions. The relationship between post size and other quick reactions was not further examined due to a significantly smaller number of such reactions.

Conclusion

The research conducted on the chatbot *Andrija* has yielded several significant findings. The initial part of the study emphasizes the multifaceted role of *Andrija* as a chatbot important for disseminating basic information about the pandemic and assisting the public in making informed decisions. However, certain limitations were identified in the design and implementation of *Andrija*, particularly regarding information dissemination.

The subsequent phase of the research centres on the media coverage of chatbot *Andrija* on the Facebook and its impact on user perception and the general public. The results indicate a notable level of media attention during a specific timeframe. An examination of Facebook posts about *Andrija* revealed variation in post size, with a focus on visual media such as images/videos and links to official websites. Furthermore, the analysis of user reactions to *Andrija*'s posts demonstrated a largely positive reception, characterized by a high number of "Like"

reactions and a pronounced emotional connection reflected through "Love" reactions. Nevertheless, variations in user perception were observed.

Investigating the correlation between post size (word count) and reactions to Facebook posts indicated no statistically significant correlation between post size and the total number of quick reactions. However, a statistically significant positive correlation was identified between post size and the number of "Like" reactions.

Considering the research objective, it is concluded that the investigation of the chatbot *Andrija* has provided valuable insights into the perception and acceptance of digital assistants in the healthcare domain, particularly amidst the COVID-19 pandemic. An analysis of media presentation and the public's response to *Andrija* on the Facebook platform has underscored significant media and user interest, as well as extensive discourse surrounding the chatbot. The research findings offer guidance for enhancing the design, media strategy, and adoption of digital assistants in the healthcare sector.

Additionally, the study has identified key factors influencing user acceptance or uncertainty and unveiled the diversity of attitudes and perceptions among users regarding *Andrija*. Analysis of user comments and reactions on Andrija's official Facebook page has yielded further insights into the reception of the chatbot, users' primary areas of interest, and feedback.

In summary, the research on chatbot *Andrija* contributes to our understanding of the role of digital assistants in communicating information about the pandemic and provides guidelines for the further development and application of such technologies in healthcare systems. The study has also shed light on deficiencies in the design and implementation of *Andrija*, emphasizing the importance of ongoing enhancements to its functionality. The research findings offer valuable guidance for improving design, refining media strategies, and facilitating the adoption of digital assistants within the healthcare sector. The identified factors influencing user acceptance or uncertainty provide crucial insights for the continued advancement of digital assistants.

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in EPSTEM journal belongs to the authors.

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