ISSN: 1803-3814 (Printed), 2571-3701 (Online)
https://doi.org/10.13164/mendel.2022.2.009



# Efficiency of Smart AI-Based Voice Apps and Virtual Services Operating With Chatbots

**Nidal Al Said**[1,✉], **Dmitry Gura**[2,3], **Dmitry Karlov**[4]

[1]College of Mass Communication, Ajman University, Ajman, United Arab Emirates
[2]Department of Cadastre and GeoEngineering, Kuban State Technological University, Krasnodar, Russian Federation
[3]Department of Geodesy, Kuban State Agrarian University, Krasnodar, Russian Federation
[4]Department of In-plant Electrical Equipment and Automation, AMTI (branch) of the KubSTU, Armavir, Russian Federation
n.alsaid@ajman.ac.ae✉, dmitrygura23@rambler.ru, karlov66@rambler.ru

**Abstract**

*The development of computer and information technologies contributed to technological advancement in artificial intelligence (AI) by introducing "smart" apps in modern smartphones and gadgets. The need to apply AI in smart apps is due to the excessive demand of users in solving their day-to-day tasks. Their effectiveness was assessed by analyzing the average statistics based on the nature of the information requested in seven blocks of questions. The study results showed that depending on the accuracy of the query formulated, the data processing to derive the results from smart apps can be very different. The analysis was based on four indicators: accuracy, conformity, non-specificity, and no-response. Another urgent issue is studying the operation of Siri and Google Assistant smart apps to assess the reliability compliance of data from requests and application development perspectives. The study objectives included: analyzing and studying AI and its different forms; collecting data on the everyday use of apps in modern smartphones and gadgets with voice support functions; investigating device compatibility with smart apps to analyze and evaluate usage efficiency; studying the dependency of smart apps usage in everyday life.*

**Keywords:** *Computer and Information Technologies, Artificial Intelligence, Voice Assistant, Chatbot, Machine Learning, SDGs.*

**Received:** 26 June 2022
**Accepted:** 29 August 2022
**Online:** 06 October 2022
**Published:** 20 December 2022

## 1 Introduction

The development of computer and information technologies (IT) has greatly facilitated the advancement of artificial intelligence (AI) [1]. Nowadays, AI is successfully applied in many spheres of human activities. In addition, it draws more and more attention in terms of its functions of responding to people's daily demands [2]. The intensive development of AI-based information technology resulted in the emergence of the so-called smart applications for modern gadgets capable of resolving human queries in the shortest possible time [3].

As known, AI is based on machine learning (ML) methods. They enable decision-making through deep learning algorithms to create alternative variations for solving the requested tasks [4]-[6].

To date, AI is widely used every day through smartphones and gadgets as a voice assistant through specially developed apps, such as Apple Siri, Google Assistant, Amazon, Alexa, and others. These apps have speech recognition functions and efficiently synthesize and process natural language to provide services. Such functions include providing answers to the user's questions; calendar planning, searching and playing music via music services; making calls and sending messages; setting the alarm or timer; online shopping; autonomously controlling and monitoring the user's health status using connected Bluetooth devices (fitness bracelets); providing weather forecast, geolocation and navigation information and many more.

### 1.1 Literature Review

The development of AI and the possibility of introducing intelligent networks into everyday applications of electronic devices are extensively studied in many fields, such as medicine, industry, the Internet of things (IoT), and Machine-to-Machine (M2M) communication [6],[7]. Some research efforts aim to find methods for integrating smart apps into communication systems as chatbots to ensure the maintenance of online services and provision of services non-stop [8],[9].

The concept in [10]-[12] for IT transformation of HR management using AI was developed with the help of software systems and technologies. This concept is cost-effective for organizations that rapidly introduce AI into the automation of functional do-mains. They allow reducing time, costs, and efforts of human resources while increasing efficiency for day-to-day maintenance.

Capabilities of communication using online apps with a chat interface were presented in [13]-[15], de-

scribing current issues for real-time customer service through e-commerce. With real-time chatbots, customer service has evolved into two-way communication, which significantly impacts confidence, satisfaction, repeated buying, and customer intentions. Following the technological advances in AI development, conversational software chat robots replace human agents in chat services. They represent one of the AI forms developed for communicating and resolving human queries using natural language. Chatbots are intended to provide users with real-time information, respond to all user re-quests, and act as an intelligent messenger, personal assistant, and even a virtual interlocutor. New features were added to the AI chatbots to process complicated user requests as executive functions. It allows using them on a virtual marketplace, providing autonomous self-services. Hence, the establishment of chatbots increased competitiveness in the "virtual market" through messengers developed for everyday trading transactions [9].

N. Nawaz and A. M. Gomes [16] demonstrated that AI opens excellent opportunities in the recruiting process since it can think intelligently like a human brain in various complex situations. The digital era is increasingly attracting attention to the importance of automating the recruitment process versus the traditional recruitment system. AI ensures a smooth operation by filtering and responding to CVs through automated messages. This technology can simplify the work when it comes to gathering information related to the candidates' experience, answering questions, and identifying the appropriate candidates for the interview.

Customer satisfaction has long been featured in marketing and information technology publications. In N. T. Thomas [17], the evolved theoretical foundations of customer satisfaction were applied to a new AI technology platform involving digital assistants. The authors explored the role of artificial intelligence in validating expectations through client satisfaction assessments. It may assist managers in understanding and determining client satisfaction degrees with the help of digital assistants.

With the first attempts to introduce AI into intelligent apps, recognizing speech and symbols in the text has become challenging. It confirms the need to develop specific systems of linguistic perception. One of such developments was a simple language model based on seq2seq in Vinyals and Le [18] for teaching spoken language. The study involved generating simple and basic conversations from rich and open data sets, which unexpectedly yielded correct answers to the questions asked.

### 1.2 Task Statement

This study aimed to evaluate the efficiency of smart apps with AI-based voice assistants and the need for using virtual services managed by chatbots. A pressing issue is a study of how Siri and Google Assistant smart apps work to determine the relevance of the data provided from queries and outline the development perspectives.

The study objectives included: the analysis and study of AI and its existing variable forms; data collection on the daily usage of apps in modern smartphones and gadgets with voice control option; investigation of device compatibility with smart apps for analysis and evaluation of their usability; study of the dependency of smart apps usage in everyday life.

The scientific novelty of this study is the scientific interest in the possible interaction of human factors with artificial intelligence to solve daily tasks and their performance assessment based on the provision of reliable data.

## 2 Materials and Methods

This study explores the possibility of integrating protocols of AI-based apps in electronic devices to develop smart applications for daily use. AI is a network that combines ML algorithms with electronic gadget program protocols to create a voice assistant (or real-time chatbots) for solving tasks requested by users. Chatbots are typically virtual assistants at virtual e-commerce platforms and marketplaces [11],[16].

Voice assistants in smartphone apps may differ from the manufacturer's operational system (OS). For example, Siri can only function with the iOS developed by the American corporation Apple, the world's largest manufacturer of personal and tablet computers, audio players, smartphones, and soft-ware. Google Assistant runs on smartphones and gadgets functioning with Android OS developed by the Open Handset Alliance and Google.

Before outlining the methods of this study, a brief summary of different AI forms for the development of smart apps is presented in Table 1.

### 2.1 Architecture and Principle of the Recognition System

Each AI-based app with features of the voice assistant has specific architecture. It is based on inter-connected systems to perceive the incoming user's speech in the form of a voice and text message that the user can enter. An essential requirement for the algorithm implementation to capture the requested information and display the results is a system that functions in two modes of operation: textual commands as a set of messages and voice commands as input information using a user's voice.

The architecture by which such a system can be constructed is illustrated in Figure 1, describing how a user command is passed to an app containing middleware to receive a response. The second mode is characterized by the user entering speech commands, where voice-to-text conversion is completed before the voice is sent to the middleware application (API). The model that links AIML scripts to an app on the Android OS is Mid-

Table 1: Forms and examples of AI integration in apps.

| Name | Specifications | Examples | Apps |
|---|---|---|---|
| AI with a limited range of features | Quite a weak form of AI (inferior to the level of human development) used in a specific field with limited applications. It is not an efficient solution for offline operation in a particular business area. | The app can recognize the human voice and appearance but cannot perform the functions of managing the home, driving a car (smart technologies) | Apple Siri<br>Google Assistant |
| General-purpose AI | A strong form of AI (similar to the human level of development) used in multiple fields with advanced functions. It is an effective solution for an autonomous operation in various business areas, which exceeds and equals human abilities. | The app can transform into a humanoid robot with many functions, such as voice recognition, coffee making (smart technologies), writing and text recognition skills, etc. | Apple Siri<br>Google Assistant (operates with limited functions) |
| AI with superpowers | It is a conscious and self-aware form of AI (above the human level of development) used in any field and capable of instantly solving various problems, significantly exceeding human capabilities. | The app includes superhuman capabilities. For instance, it solves complex mathematical problems, determines the mixture components' chemical composition, chemical and physical properties, etc. | Apple Siri |

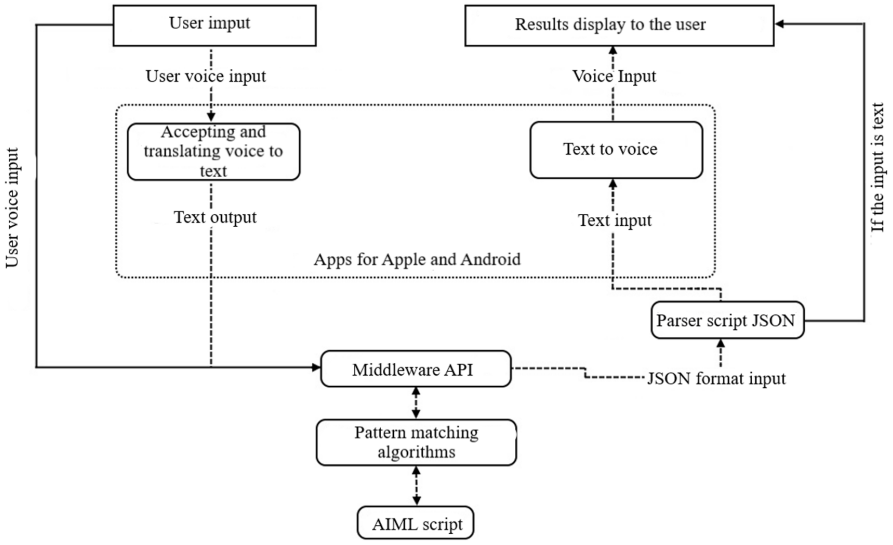


Figure 1: Architecture to build an application recognition system

dleware designed to ensure interaction between various apps, systems, and components.

Suppose a user request (command input) is received. In that case, the middleware is passed to the pattern mapping algorithms, which run the working function on the AIML scripts and initiate a process to find the correct response and available AIML scripts.

The corresponding model is sent back to the middleware when the model is found. Next, the middle-ware encodes the model in JSON format and sends the response from the requested command to the Android application for execution. Upon receiving a response, the application decodes the JSON and dis-plays the answer to the user.

Generating responses to a user request consists of two execution tasks: preparation for model selection and corresponding answers during model selection. The AIML interpretation of each entry characterizes preparation for matching patterns through two phases: a standardization process for implementing user inputs and creating entry guidance for each application. The response to matching patterns is characterized by finding the most extensive and best word-for-word matches on the entry. The response is described as a primary set of Graph files and directories containing a set of nodes and defines a primary node with branches representing

Table 2: Features of personal assistants and their performance indicators.

| Voice command features | Requested Commands | Best results | Worst results |
|---|---|---|---|
| **Administrative Assistant** | | | |
| Alarm and timer activation | "Set the alarm for 7:00 a.m." | S, GA | - |
| To-do list management | "Finish report for tomorrow" | S | GA |
| Reminders | "Appointment to the dentist at 17:00" | S | GA |
| Schedule a meeting | "Open calendar and to-do lists" | S | GA |
| Create an email | "Write to mom that I can't come." | S, GA | - |
| **Shopping Assistant** | | | |
| Overview and presentation | "Show online hardware store." | S, GA | - |
| Shopping list management | "Calculate the cost of five goods." | S | GA |
| Internet shopping | "I need to buy a watch online." | S | GA |
| Restaurant search | "Show me nearby restaurants." | GA | S |
| Cinema search | "Show cinemas nearby." | GA | S |
| Shop opening hours | "Supermarket Hours" | - | S, GA |
| **Travel and Description Assistant** | | | |
| Transport information | "How many seats are on the bus?" | S | GA |
| Route schedule | "Show the map of the bus route." | S | GA |
| Transport time | "Specify travel time." | GA | S |
| Description of the event | "What is included in the hotel package?" | S, GA | - |
| **Entertainment** | | | |
| Song identification | "Find a song currently playing." | S | GA |
| Information about movie | "Find a movie by description." | S, GA | - |
| Jokes | "Tell a joke about animals." | GA | S |
| **Miscellaneous** | | | |
| News and scientific achievements | "Tell me about the Olympic games." | S, GA | - |
| Weather forecast | "What's the weather like in Chicago tomorrow?" | S, GA | - |
| Traffic information | "Show traffic jams in Munich." | S, GA | - |
| Exchange Rates | "Show the dollar exchange rate." | S, GA | - |
| Translation | "Translate a sentence for me..." | S, GA | - |
| Holiday information | "Where did I rest yesterday?" | GA | S |
| **Bluetooth Devices** | | | |
| Pulse information | "What is my pulse?" | S, GA | - |
| Distance traveled statistics | "How far have I walked today?" | GA | S |
| Activity control | "How long did I sleep last night?" | S | GA |
| **Questions and answers** | | | |
| Random facts | "Tell some facts about space." | S, GA | - |
| Random questions | "How was your day?" | S, GA | - |
| Mathematical problems and calculations | "Calculate the runoff." | S | GA |
| Time zones | "Show Eastern Time" | S, GA | - |
| Measurements | "How many grams are in 1 kilogram?" | S, GA | - |

the first words of all templates.

Any voice assistants and chatbots are integrated into the app as follows. The beginning of the algorithm is realized with the vocal entry of the command requested by the user. When started, the app asks the user to enter voice data for the run command. After receiving the command, the speech form is converted to text to collect the program text, where text commands and values are processed on the server to receive an answer. The server processes the scripts in JSON format and runs the commands to get the response from the bot after analysis. With the acceptance of voice input, a voice output occurs, where the bot's response can be converted into voice and played using the loudspeaker of the electronic device [19]-[22].

## 2.2 Research Devices

Siri is the personal voice assistant for Apple devices running on iOS. Siri's most common applications include web browsing and dictation. Siri is currently undergoing restructuring to introduce new capabilities and adapt to new devices.

To study smart apps with a voice assistant, Apple iPhone XR 64 Gb and Apple Watch Series 6 were used as connected devices with Bluetooth and Wi-Fi support. The requested orders were completed on 21/11/2021 and were performed on six Apple devices to compile average statistics. Based on data obtained as a Table displaying main requests with response rates (better and worse), the comparative characteristics of the indicators were compiled to determine the efficiency of the Siri smart app.

Xiaomi Redmi Note 8T and Xiaomi Redmi Note 9 smartphones with the support of Bluetooth de-

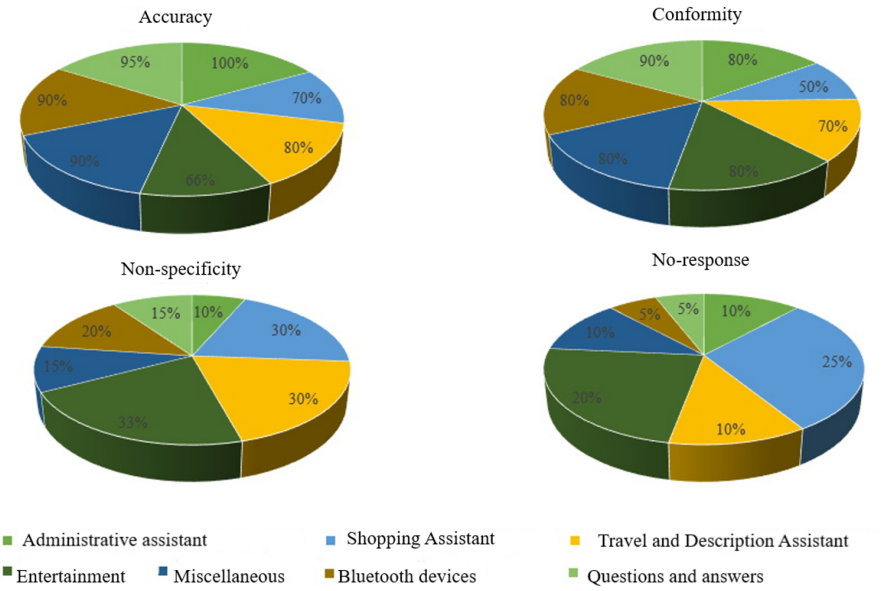


Figure 2: Indicators of response performance with Apple Siri as per Table 2.

vices (Xiaomi Mi Band 4 wireless headset as a fitness bracelet) were used as Android devices for assessing the Google Assistant voice assistant performance.

## 3 Results

For assessing the effectiveness of Siri and Google Assistant AI-based voice assistants, a study was conducted to identify voice commands by displaying the requested information as seven blocks with different types of questions. The results are presented in Table 2, where the Siri application is referred to as "S," and Google Assistant as "GA." The results were presented using commands based on four indicators:accuracy, conformity, non-specificity, and no response to the command.

More detailed data from Table 2 are taken from the responses in user apps shown in Figure 2 for the Siri voice assistant on iOS and Figure 3 for the Google Assistant voice assistant on Android OS. The assessment was performed based on four indicators that also served to evaluate the reliability of the data provided using voice and text commands.

Assessing the effectiveness of applications based on the indicators involved requires estimating the dependence of the requested command on the response and perception of information by a smart app. Thus, the precision indicator establishes the cor-relation between the given command and the accuracy of the sentence's construction. For example, the sentence in the command "Siri, show me the nearest restaurant" may generate an incorrect answer, indicating incorrect question wording. When repeating the requested command in a different context, such as the sentence "Siri, show me available restaurants nearby," the probability of Siri presenting a reliable result will depend on the match between the response and the reality.

Conformity plays a vital role in the response since the application can show an unreliable result that is not true in real-time. Depending on the coherence of the result obtained, a non-specificity indicator is used to determine the extent of the answer's fuzziness. An example may be the heart rate measurements using a Bluetooth device (Apple Watch). Thus, multiple measures may lead to varying results, indicating that the data provided is fuzzy. In other words, the non-specificity indicator is used to verify the validity of the results. The "no-response" indicator is used to determine a performance score if the application fails to find a response to the user's request.

Figure 2 shows seven blocks of voice commands to the Siri app. The study results showed the lowest correctness for the "Entertainment" and "Shopping Assistant" block of questions. It can be attributed to the lack of compliance with non-specific data and the inability to answer some of the questions in these blocks. This smart app is best suited as an administrative assistant for everyday tasks and answering questions. Besides, it can also serve as a guide and help understand navigation and route construction. However, the app cannot accurately calculate the time spent on transportation and delivery. Unlike other AI-based apps, Siri is more suited to the task at hand and assists the user in resolving various re-quests as a personal assistant.

Figure 3 shows seven blocks of requests in the Google Assistant apps based on voice commands. The study results showed that Google Assistant is a less effective administrative scheduler of daily tasks due to the poor accuracy based on the fuzzy results of the query. Compared to Siri, Google Assistant can recognize a well-pronounced phrase for processing a request, which in some cases may process the same request more than once. Therefore, an inconclusive answer is obtained based on a poorly formed sentence submitted for processing in the app.

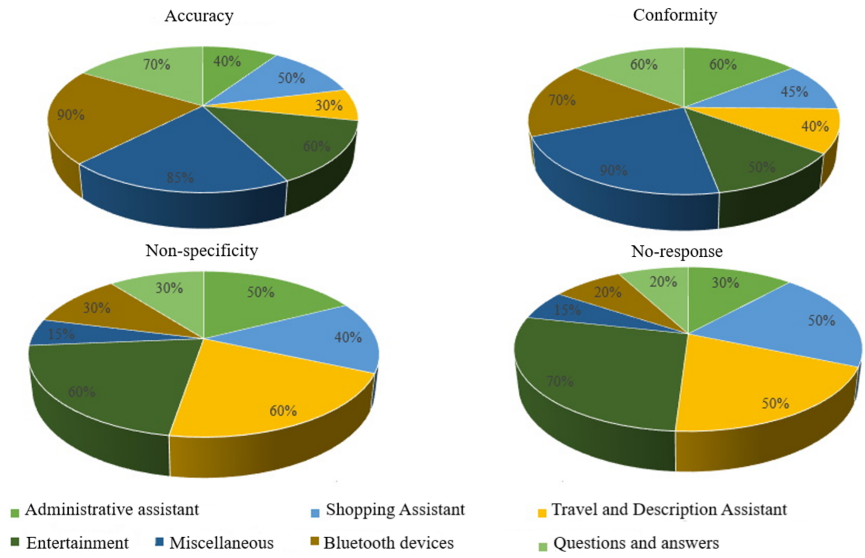


Figure 3: Indicators of response performance with Google Assistant as per Table 2.

For Google Assistant, the lowest rating was noted for the Travel and Description block. The use of Google Assistant as a guide here is ineffective, and it can be rather used as a guide as a navigator. The block with Bluetooth-connected devices represents the highest score, with a 70% match based on 30% non-specific data. The voice assistant can answer the questions in the correct form of the requested information and the repeated wording of the requested information.

## 4 Discussion

A smart assistant is a built-in computer system that features AI-based ML methods that help people help competently in daily life. The use of smart assis-tants has gained popularity due to their helpful fea-tures that contribute to scientific and technological advancements. The work describes the classification and systematization of recent achievements in the development of artificial intelligence in systematical-ly based intelligent applications [23]. Following the review, a taxonomy of smart assistants is proposed with a set of potential orientations for research in various application areas.

The paper presents a study on integrating voice assistants with AI using IoT-based smart speakers in the educational process [24]. The authors also considered the lack of supported languages for the perception of programs since voice assistants are unable to perceive all existing languages. They also pointed to an ineffective security system and protective filters in the form of security protocols, indicating a decrease in the effectiveness of using AI in electronic devices [25].

With the development of AI for implementation in smart apps, researchers Park and Seo [26] concluded that voice assistants could think and experience emotions just like an average human. The authors investigated a website with tweets collected using Streaming API that separated positive, negative, and neutral opinions using VADER (sentiment dictionary). Changes in sentiment scores were described as positive, neutral, and negative by voice assistants Siri and Google Assistant. The results were derived as statistical tests.

The authors in work [27] consider devices used in human-computer interaction and learning. They provide an overview of the working systems of Siri, Google Now, and Microsoft Cortana smart apps in the context of AI development for intelligent voice assistants. These AI-programmed assistants create human-computer interaction through the natural language used in digital communication. Therefore, this study's overall goal was to explore the potential applications of IPAs using advanced cognitive technologies and Natural Language Processing.

Artificial intelligence is increasingly integrated into people's everyday lives, and its development progressively moves it into the social sphere. Due to ubiquity and progressive anthropomorphization, chatbots are no longer perceived as mere helpers, and their way of interacting brings them closer as friendly companions [28-30].

## 5 Conclusion

With the development of computer and information technology from the point of view of AI, the implementation and effectiveness of using smart networks and applications based on ML algorithms are widely studied. This study examines the effectiveness of developed AI-based voice assistants, which are now an integral part of everyday lives.

This study is devoted to analyzing the effectiveness of smart applications Apple Siri and Google Assistant in everyday use. Efficiency was assessed by analyzing average statistical data according to the nature of the requested information in the form of 7 blocks of questions. The study results showed that depending on the

correctness of the formulated query, data processing for deriving the results from smart apps may differ.

The analysis was based on four indicators: accuracy, conformity, non-specificity, and no-response to the requested questions using voice input and query execution commands based on Internet searches. Following the evaluation of the effectiveness, these voice assistants were found to be necessary for solving various everyday tasks, allowing for information to be obtained when offline.

Based on the derived results, the dependence of the indicators was established. Afterward, the effectiveness of obtaining reliable data in real-time was determined. Conformity was defined based on the request accuracy to the device to reduce the non-specificity and obtain a reliable response. The effectiveness of AI can be improved by adding new functions to provide the user with rich functionality. That indicates the prospects in the development of artificial intelligence. The vector of further developments will be aimed at studying protocols and scripts when writing intelligent programs to create intelligent chatbots in virtual platform services.

**Acknowledgement:** Not applicable.

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