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Comparative Analysis of Voice Powered Assistants

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Abstract: ***This paper discusses about voice assistants, compares several voice assistants like Siri, Alexa, Cortana and Google Assistant. Advantages and disadvantages of each assistant have been summarised. Performance analysis has been conducted and market share of every assistant has been studied. Limitations and future scope of each voice assistant has been reviewed.***
Keywords: Voice Assistant, Virtual Assistant, Siri, Alexa, Cortana, Google Assistant, Voice Recognition

I. INTRODUCTION

The smartphone market is currently one of the most competitive in the entire world, which is dominated by companies like Samsung, Apple, Xiaomi, Google and Microsoft among other things, being involved in a close race to keep or gain the lead [1]. Initially, a device's success or failure was only determined by its hardware, but today software has emerged as one of the major determining factors. The Virtual Assistant is one important piece of software that is causing a stir, a tool that enables spoken communication between users and their equipment. The most popular of these tools are Google Assistant and Apple's Siri [2] . One can use these applications to carry out activities like phone calling, announcing alarms, and monitoring for statistics like the weather . Although the tools work well, they have a few shortcomings. To begin with, the majority of them frequently need a Wi-Fi or mobile data connection to function. This is due to the fact that they first record the user's speech as they vocally issue a command, after which they upload the data to a server online. The server then analyzes the information and decodes the code, and then is delivered back to system where it is ultimately put into action. Such internet-dependent applications' functioning suffers substantially in the absence of the internet. For these apps in order to quickly carry out the customer's orders, a high bandwidth is also necessary. The programmes typically work slowly and can frequently annoy the user if this isn't provided. There are also other modules that must be built that are not included in the closed-source solution already on the market [3]. These vendors frequently have a predisposition to focus on environments that promote their objectives. Furthermore, internet access is not only expensive, particularly in underdeveloped nations, but it also uses a lot of battery, particularly when paired with other active applications. The limited battery capacity in mobile devices has been a significant problem, and tech firms are developing solutions to increase the present day size.

II. LITERATURE REVIEW

Mobile applications known as virtual assistants serve as software agents or middlemen to facilitate user-mobile device interaction. Depending on customer's input, locale - based services, and the capacity to receive data from a broad range of internet origins, such as telecommunication-news, the stock market, traffic-congestion information, customer schedules, and market prices, among others, these applications can carry out activities or provide services for a person. Google Assistant, Apple Siri, Microsoft Cortana tools .
Speech input is intended to be used with mobile digital assistants. This is due to the fact that speech is perfectly adapted to smartphone computing, as a single vocal order can carry out a range of operations that ordinarily need for numerous clicks and pushes [4]. This makes using a smartphone more simpler when a user's hands and eyes are occupied by a more urgent duty like driving .

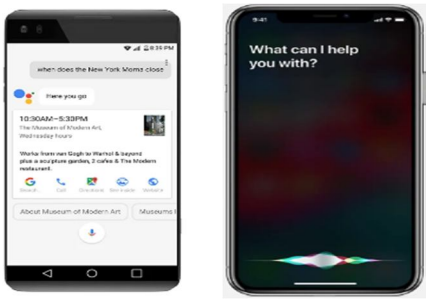


Fig. 1. This figure shows the user interface for Google Assistant (left) and Apple's Siri Voice Assistant (right).

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The concept of using speech to communicate with a smart phone was considered pure science fiction until recently. All of that has changed. In an effort to provide the best user experience, firms like Apple, Google and Microsoft are leading the evolution of these applications. These programs have been created with voice control in mind [5]. Because of this, an increasing number of individuals increasingly ask their mobile smart phones to perform a variety of tasks, including writing emails, placing calls, and sending messages.

In the smartphone market, virtual assistants are swiftly gaining popularity. What was once thought to be sci - fi is now a reality thanks to these applications. Users can now communicate with their gadgets solely using voice commands. Despite these encouraging advancements in the pursuit of ergonomic simplicity, the current crop of applications are not without flaws. After experimenting with Alphabet's Google-Assistant and Apple-Company's Siri, it was determined that these applications are "data absorbers" because of how much internet connection they need to operate. The fact that these applications are only supported by expensive gadgets, which are not available to everyone on the market, is another disadvantage.

III. GENERAL COMPARISON OF VIRTUAL ASSISTANTS

Table 1. This table shows the Virtual Assistant Comparison based on KPI's like Developer, Release Date, Operating System, Platform on which assistant works and the languages compatible with the voice assistant.

KPI	Siri	Google Assistant	Cortana	Alexa
Developer	Apple	Google	Microsoft	Amazon
Release	October 2011	May 2016	April 2014	November 2014
OS	IOS, Mac OS, TV OS, Watch OS	Android	Windows, Xbox OS	Fire OS
Platform-Device	IPhone, Ipad, Mac, Apple Watch and TV	Smartphone, Tablet, TV, Speaker, Android Watch	Computer, Xbox	Amazon Speaker
Languages Available	English, Chinese, Danish, Hebrew, German, Arabic, Finnish, French, Italian, Japanese, Korean, Malay, Norwegian, Portugese, Russian, Spanish, Swedish, Thai,	English, German, Hindi, Japanese, Dutch, French, Portugese ,Italian, Korean, Spanish	English, Chinese, Danish, Hebrew, German, Arabic	English, Japanese, German

IV. STATISTICS OF VOICE ASSISTANTS

The below bar graph shows the rate of correctly answering the queries asked by the users in five domains- Local, Commerce, Navigation, Information and Command. Google Assistant tops the list with most correctly answered questions followed by Siri and Alexa.

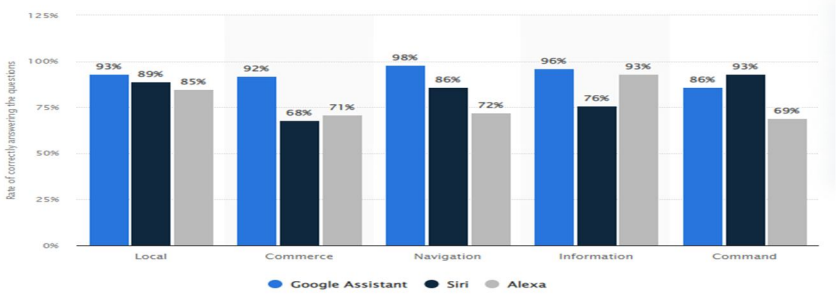


Fig. 2. This figure shows rate of correctly answering the questions between Google Assistant, Apple's Siri and Amazon's Alexa.

The below infographic shows Siri is the most used Voice Assistant which has a market share of around 45% followed by Google Assistant (29%), Alexa, Bixby and Cortana.

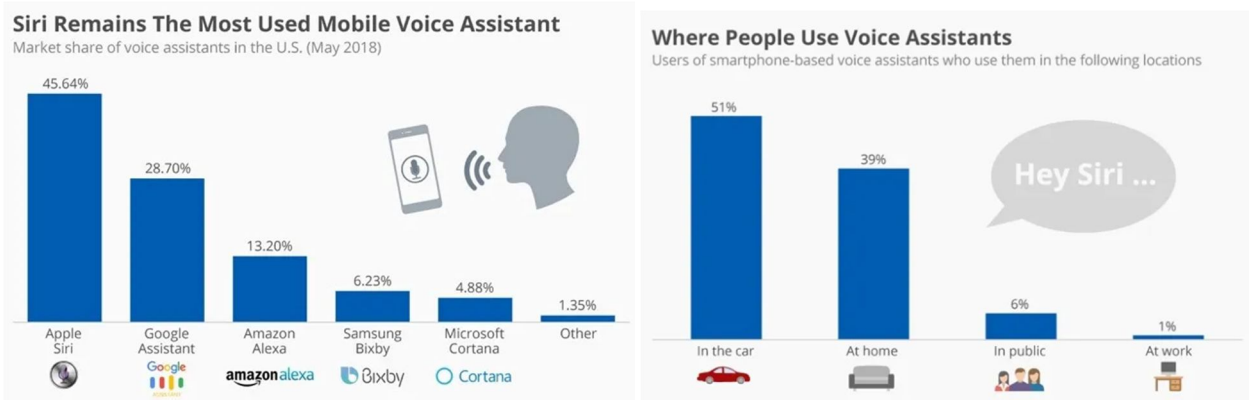


Fig. 3. This figure shows the most used assistants (left) and place where assistants are used (right) like in car, home, public or at work.

Most of the people use voice assistants in a car, followed by home, public and at work. Android auto is the frequently used voice assistant in a car, while Google Assistant is the most used at home.

Consumers claim that smartphone users prioritise basic info search tasks highly. When it pertains to voice assistant use on smartphones, informational and entertaining use cases come first. Asking questions is the most common use case on a "ever attempted," monthly, and daily basis. Each month, more than 50% of users use voice search capabilities.

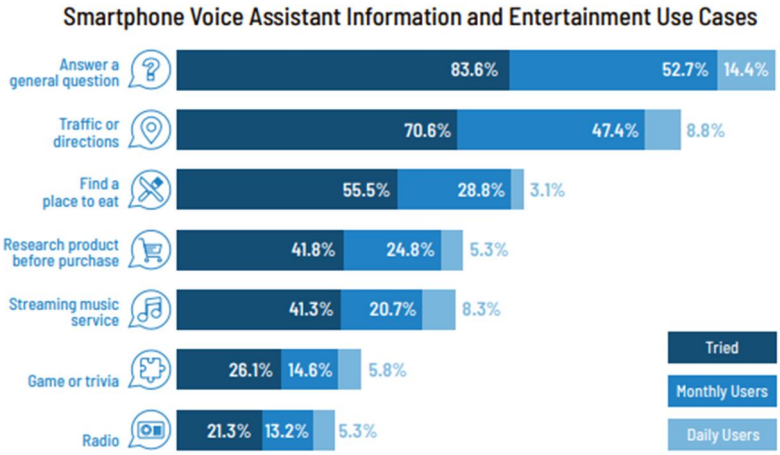


Fig. 4. This figure shows the Voice Assistant Use Cases along with the percentage of monthly users and daily users

For consumers who are constantly on the go, it is not surprising that the next two most frequent monthly behaviours entail searching by location to find either directions or a restaurant. The fact that voice search for products was more popular compared to any of the other entertainment options, however, may surprise some industry watchers.

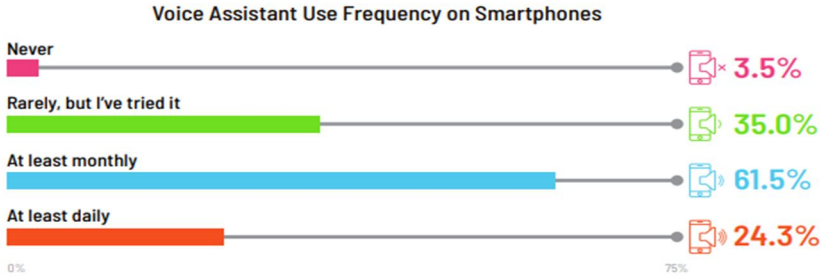


Fig. 5. This figure shows the usage frequency of voice assistants with categories like never, rarely, monthly and daily.

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A voice assistant has reportedly been used on mobile devices at least once by 96.5% of smartphone owners. More noteworthy is the fact that 61.5% of people use voice assistants on their cellphones on a regular basis. Almost one in four people claim to regularly use a voice assistant on their smartphone [6]. It is difficult to consider voice interaction as primarily a smart speaker phenomenon given the statistics. The majority of consumers use voice regularly today, a trend that began with cellphones.

The car is another important user environment for modern consumer voice assistant use, in addition to smartphones and smart speakers [7]. A little over 50% of customers claimed to have used a voice assistant in a car. Both connecting via Bluetooth to the voice assistant on their smartphone and utilising the pre-installed speech solution in the automobile were used approximately equally.

However, the disparity increases when you utilise Apple CarPlay and Android Auto in addition to the Bluetooth connection to cellphones. The total comes to 39%, almost twice as many users as those who have tested a native voice recognition built into a car.

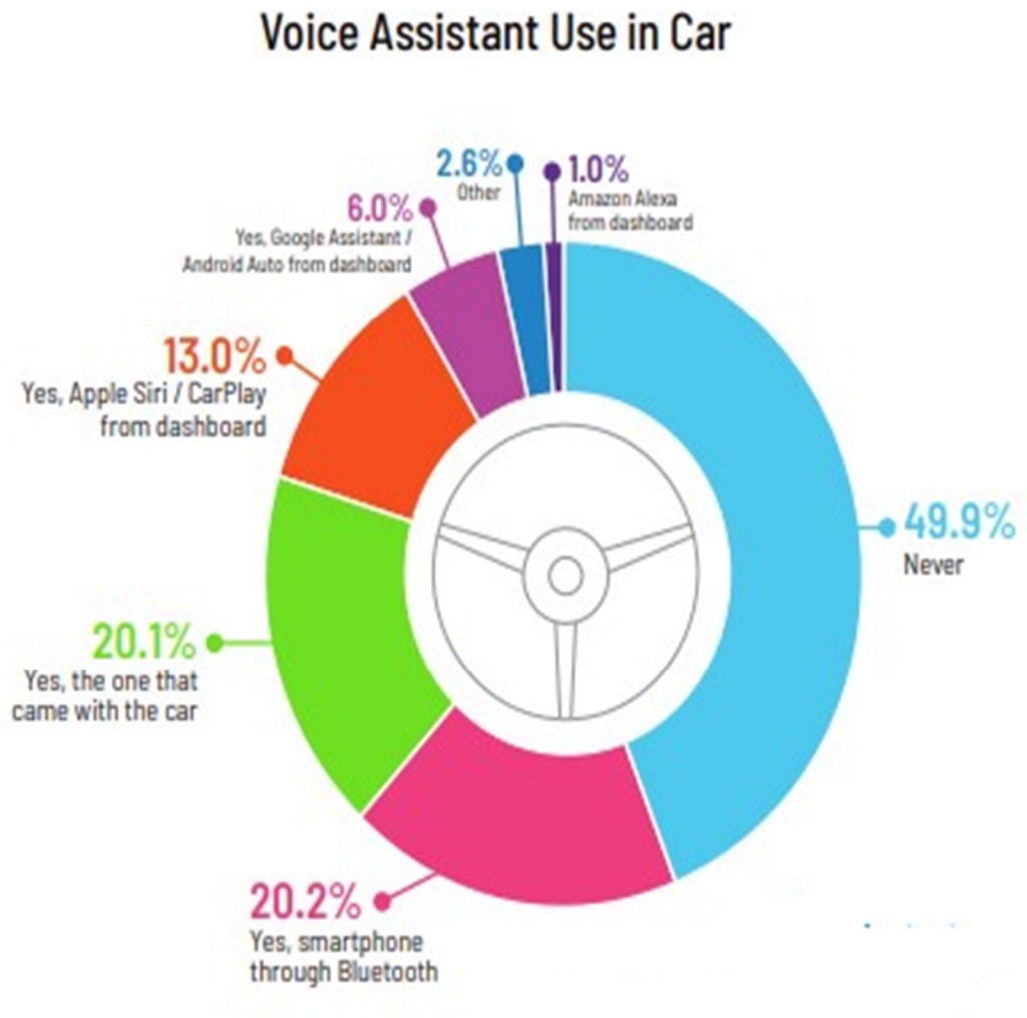


Fig. 6. This figure shows the usage of voice assistant in a car.

Amazon Alexa is the player who is essentially left out of the car. Similar to Apple CarPlay and Android Auto, it lacks the devoted smartphone user base and an official dashboard location. Amazon is striving to secure that dashboard prominence, but it will probably take years before there is a sizable installed base. That is part of the idea behind Echo Auto, which is a means to mount a small built - in microphone on the console that can pick up a driver's speech in a noisy environment like a car better than the smartphone-based Alexa app can. It is a solution to give Alexa access until widespread integration with automotive infotainment systems.

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V. ADVANTAGES AND DISADVANTAGES

Table 2. This table shows the Pros and Cons of Various Voice Assistants based on its features, use cases, efficiency and ease of use.

	Advantages	Disadvantages
Siri	• By driving and speaking orders into your iPhone, you may locate the closest places, including restaurants, theatres, malls, and other establishments. • Text messages can be read or opened with a command. • Simply viewing maps for searching and finding. • Make reservations. • Hold the phone, plus a lot more.	• Siri's primary drawback is that it requires Internet access to use. • The user must speak in English in order for the system to locate maps. Siri cannot be used to access maps in other languages. • When using an iphone voice command, interpretations do not happen correctly.
Alexa	• There are numerous useful aspects and capabilities of Alexa. Alexa recognizes natural language and can understand practically anything users say. • Alexa is quite flexible. • Because Alexa runs more quickly than the competition, using her will save you time and make your day better. • Alexa seems to operate more quickly and efficiently. Obtaining the weather report immediately, as an example.	• Alexa gives individuals poor dating advise. • The sound quality is subpar. • Does not allow setting or cancelling of alarms from different rooms.
Cortana	• Cortana Simple social networking platforms, such as Facebook, Twitter, etc. • Protecting against viruses and other dangerous assaults by providing current security. • Constantly adding new features so there is never a delay for an update or a new release. • This style is for the new generation.	• Flexibility declines. • The costs in the future are unknown. • Cortana cannot upgrade the oldest Windows versions, such as Windows 2000 and Windows 2001, thus new PCs with Windows 10 cost more.
Google Assistant	• Video can be cast from Google Assistant to your TV. • It has the ability to recognise various voices and record the voice. • It also has the ability to cast audio between one or many devices. • It is compatible with YouTube Music and Google Play Music.	• It lacks an integrated screen. • Search Engine Assistant Emails and messages cannot be read or sent. • It is only able to recite items in our main calendar. • There is no audio out port on it. • Not changeable Start a phrase

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VI. PERFORMANCE ANALYSIS OF VARIOUS VOICE ASSISTANTS

		Alexa	Google	Siri
1	**Personality** VA's language, accent, tone, speed of speaking, choice of words, emoticons and intonations.	3	4	2
2	**Speech Recognition** The ability to decode the user's speech into words.	4	4	4
3	**Contextual Understanding** The ability to understand what the user is talking about, especially with respect to the user's environment (culture, location etc.)	4	5	4
4	**Output Quality** The quality of VA's responses – whether voice only or accompanied by visual cues and interactive possibilities.	3	5	3
5	**Competence** The ability to accomplish the tasks requested by the user.	3	4	4
6	**Addressing Concerns** The ability to explain what is done with the data and recordings to help ease the privacy concerns and allay the AI freak factor.	3	3	2
7	**Discoverability** The ability of the VA to explain its skills and capabilities to the user	2	5	3
8	**Error Handling** The ability of the VA to handle misrecognized speech or commands.	2	4	3
9	**Interactions** Possibility of multi-modal interactions with the VA – visual cues, option to type, suggestive buttons.	2	4	3
	UX Score	26/45	38/45	28/45

Fig. 7. This figure shows the Performance Analysis of Voice Assistants

The above table analyses the performance of Alexa, Siri and Google Assistant based on key parameters like personality, speech recognition, contextual understanding, output quality, competence, addressing concerns, discoverability, error handling and interactions.

VII. LIMITATIONS

1) *Siri:* With inadequate cellular service, Siri is inoperable. Strong cellular connectivity is required for communication with cloud servers. Low cellular coverage results in Siri's functioning being constrained [11]. It can only understand you if you speak a specific language, which indicates that it has linguistic problems. voice recognition fails.
2) *Cortana:* One person can only train the Cortana at a time. The only term used in this format is "Hey Cortana." When Cortana starts by opening the screen, it only completes specific tasks—not all those that are possible—in order to protect your privacy [8]. Less compatible with the platform utilized by application makers and customer-care, but more compatible with Windows. Access on iOS and Android is challenging .
3) *Alexa:* Multiple pronunciations are not understood by Alexa. This issue can be resolved by adding data from various English accents, albeit keeping such a large amount of data presents its own challenges [9]. For developers, several voice profiles are unavailable.
4) *Google Assistant:* It has no strategy in place to monetize voice assistants. Google allows users to operate numerous accounts at once, making it less secure [10]. Multiple tasks can be completed by Google Assistant with a single voice query .

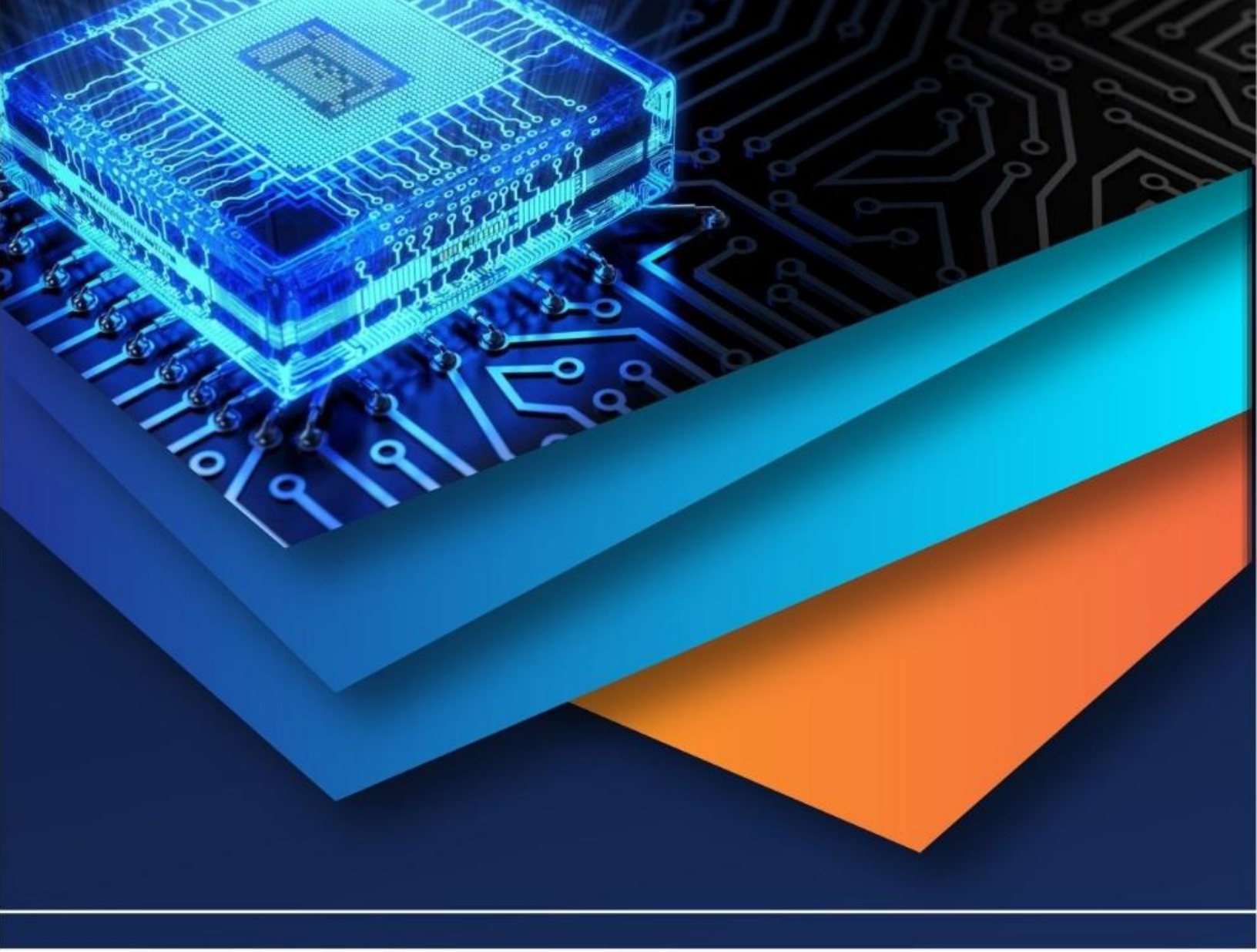
VIII. CONCLUSION

In Planning and organising chores Google and Siri performed best. When buying online, Alexa performed better. The nature of Cortana is adaptable. Google Assistant makes advantage of the most popular search engine in the world, Google. The best virtual assistant is therefore the Google Assistant.

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