

HOW VOICE ASSISTANTS ARE TAKING OVER OUR LIVES - A REVIEW

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Abstract : Although voice recognition systems and techniques existed for a long time, but it is only now, with the advent of voice assistants that they are rapidly becoming an integral part of our daily lives. A voice assistant is always with you – in your car’s navigation system, tablet computer, smart phone, smart TV, smart watch, etc. – ready to help you anytime, anywhere. This digital technology, which is still in its growing phase, is a result of constant evolution in the areas of Artificial Intelligence, Machine Learning and Natural Language Processing. Some of the most successful voice assistants are Google Assistant, Apple’s Siri, Amazon’s Alexa, Samsung’s Bixby and Microsoft’s Cortana. Owing to their intelligence, convenience and user-friendliness, assistants are becoming increasingly popular with the next generation. This paper will discuss the underlying working principle of voice assistants, their applications, security and privacy issues and future promises that they hold for us.

Index Terms - Voice Assistant, Artificial Intelligence, Smart Assistant, Speech Recognition, Digital Assistant, Natural Language Processing

I. INTRODUCTION

As computers, smart phones and other hand-held digital devices continue to become more accessible and affordable, the expectations and demand for more advanced interfaces is considerably on the rise. This has resulted in the dawn of new interfacing experiences in the form of touch-screen and voice-control over the last few years. But a smart phone’s small touch-based keyboard can be slow and frustrating to use [6]. On the other hand, the voice-recognition technology provides a more effective, natural and intuitive input mechanism allowing users’ hands to remain free. Due to its ease of access, it is now available in the form of smart voice assistant application on most smart phones, tablets and laptops and even, in the form of dedicated voice-controlled home speakers such as Amazon Echo and Google Home.

II. WHAT IS A VOICE ASSISTANT?

A Voice Assistant, also known as Smart Assistant or Virtual Personal Assistant or Intelligent Personal Assistant, is a software agent that can perform tasks or services for an individual [2]. From engaging in a friendly two-way conversation to helping you with simple tasks like setting a reminder to even more complicated tasks such as ordering a product online – voice assistants can perform a multitude of actions. These digital assistants are intelligent enough to understand the meaning and context of a query and deliver corresponding responses. Moreover, in process of responding to users, assistants also tend to learn from them by analyzing their patterns and preferences.

Many companies have designed their own voice assistants, such as Amazon Alexa, Google Assistant, Microsoft Cortana, Samsung S Voice, Bixby etc., using different approaches [1] but the character traits or “personality” of each assistant is different from the others. What makes an assistant stand out is its efficiency and accuracy in responding to a variety of questions, support for multiple languages, contextual understanding, and ability to interact with and even control other applications. A little humor and wittiness in its responses makes a voice assistant even more customer-friendly.

III. HOW DO VOICE ASSISTANTS OPERATE?

Although accessing a device using voice commands is an intuitive way of human-system interaction, but the technology behind these smart assistants is not as simple as it seems. In fact, it involves a combination of sophisticated algorithms, machine learning and specialized hardware. For instance, home speakers, such as Echo or Google Home, come equipped with a microphone to capture voice input, a small embedded processor - which always needs to be running for quick processing of the inputs given - and a speaker to output voice responses for user’s queries. In addition, assistants require internet connection to access the cloud.

Generally, to make a voice assistant work, it has to be activated using a special greeting phrase or ‘wake word’. As an example, “Alexa” is the default wake word used to activate Amazon Echo home speaker. Likewise, Apple’s Siri responds to “Hey Siri” and “Ok Google” or “Hey Google” are used for Google Assistant. Once the assistant is triggered, the user can begin making inquiries or give it a command to carry out an action. This two-way interaction is continued in the same way as two humans converse with each other using their natural language.

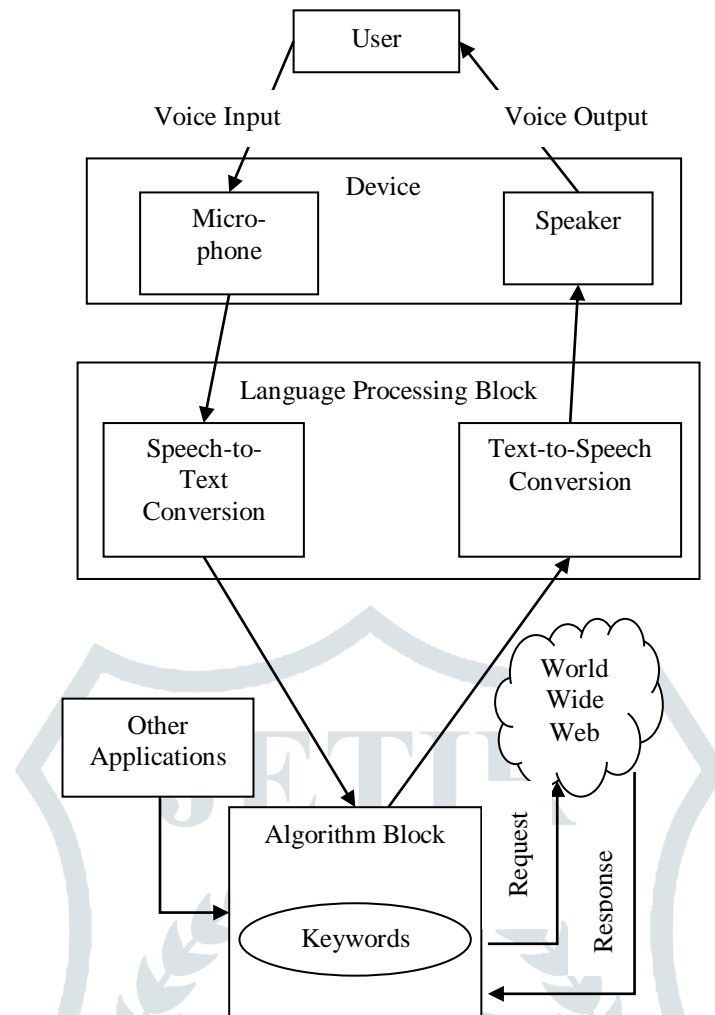


Fig 1: General Architecture of a Voice Assistant

Figure 1 shows the general architecture of a voice assistant. The first phase involves capturing user's speech through a microphone. Once the user has finished speaking, this speech is stored in the database for further processing [10]. In the next phase, this recorded speech is converted into text and analyzed to understand its meaning and context [9]. The subsequent phase involves sending it over the Internet for processing on the cloud service run by its developer. Finally, when the response against the command is identified, the device either generates voice output via its in-built speaker or responds by carrying out the desired action.

The voice assistants on smart phones also allow text input in addition to voice input. Nevertheless, in either case if the assistant is unable to decipher the input command or question, it asks the user to retry by rephrasing the sentence or by providing more details about the context.

IV. APPLICATIONS

Speech recognition technology has come a long way since the introduction of first speech recognition system which could only understand digits. Today's digital assistants support numerous applications.

Below is a list of some common tasks in which most voice assistants can be of great help:

- **Answering Questions:** Voice assistants not only support you in finding the information relevant to specific people or events but can also talk to you in the same way as other humans do. Moreover, they can do all kinds of calculations, give you definitions and even tell you a joke [10].
- **Reading weather forecast:** Assistants can successfully deliver weather forecast for the next few hours, next day or even next week.
- **Voice-based navigation and traffic alerts:** Voice technology in your car's navigation system assists you about the optimized routes, while also keeping a watch on traffic jams or accidents in the way, thus making your travelling faster and safer.
- **Reading latest news, mails or messages:** Voice assistants can read your mails, messages and even the latest headlines from the source of your choice.
- **Sending messages and making calls:** You can tell your voice assistant to type and send a message or place a call to a friend on your behalf.
- **Controlling other applications:** Voice assistants can control other applications on your smart phone – of course, there are protocols are involved. For example, when you give an instruction to open the Settings of your phone or execute any other installed applications, your assistant will simply follow.

- **Setting alarms, timers and reminders:** You can tell your voice assistant to wake you up every day at 6 in the morning and the assistant will quickly set an alarm. Similarly, assistants can be directed to set timers or save reminders about your important events such as meetings and birthdays.
- **Playing music:** Voice assistants will happily play your favorite song from the music library on your device, or stream it for you from the cloud.
- **Searching a specific file:** You can make your smart phone-based assistant to carry out a quick search to locate an existing file.
- **Turning lights on and off:** In smart homes, smart assistants can be directed to switch lights on and off.

Voice assistants are not just limited to these application areas. Developers are exploring more possibilities and in the near future, assistants will play a vital role in home automation.

V. LIMITATIONS

Despite their wide range of applications, the present day voice assistants are not free from limitations. Recognition of speech in a noisy environment is one of their biggest challenges. Also, for accessing the information over the cloud, these require a strong internet connection. Moreover, assistants still have a long way to go to be able to efficiently handle tricky questions or commands. This can be achieved by advanced training of voice recognition module. Furthermore, developers are currently working on improving their smart assistants' abilities to distinguish between various accents and dialects. And finally, emulating human emotions and expressing them is other major concern which requires delving into further research.

VI. ACCEPTABILITY AND SECURITY ISSUES

Even though voice assistants are highly in demand, yet they are surrounded by some acceptability and security concerns. In a recent study, it has been concluded that users often feel uncomfortable and embarrassed while using voice assistants in public [5]. Their concerns mostly stem from the fact that their voice commands are audible and therefore, accessible to strangers, which results in hesitation and therefore, an alteration in their attitude in a social setting [4].

Another study revealed about the potential privacy violations by all the major assistants which collect voice data from end-users. People are concerned about their voice assistants actively listening and thereby, hacking their private information which could impact their trust on these digital devices [11]. With the ever-increasing presence of these smart assistants around our homes, cars and offices, there is a need to be even more concerned about the growing security and hacking risks these might pose.

VII. CONCLUSION

In conclusion, the introduction of digital voice assistants has truly revolutionized the way humans interact with machines. Their growing popularity can be directly linked to the recent advancements made in the fields of Artificial Intelligence, Speech Recognition and Machine Learning. Developers are constantly adding new features to enhance the capabilities and performances of their voice assistants. Despite their popularity, several security and privacy concerns are associated with their usage which cannot be overlooked and the developers need to ensure users' trust. Nevertheless, voice assistants are taking you one step forward towards complete automation, thus making our lives more comfortable. In future, this technology is only expected to flourish at an unprecedented rate and soon there will be a world where you could talk to things.

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