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Introductory Chapter: Virtual Assistants

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1. Introduction

The application of Virtual Assistants (VAs) is growing fast in our personal and professional life. It has been predicted that 25% of households using a VA will have two or more devices by 2021 [1]. A virtual assistant is an intelligent application that can perform tasks or provide services for a person responding to orders or inquiries. Some VAs can understand and respond to human speech using synthesized voices. Users may use voice commands to request their VA to answer the questions, manage home appliances, control media playing, and handle other essential activities like email, creating the actions lists, and organize the meetings on calendars [2]. In the Internet of Things (IoT) world, an VA is a popular service to communicate with users based on voice command.

VA capabilities and usage are rapidly rising, thanks to new technologies reaching the people's requirements and a robust focus on voice user interfaces. Samsung, Google, and Apple each have a considerable smartphone user base. Microsoft's Windows-based personal computers, smartphones, and smart speakers have an intelligent VA installed base. On Amazon, smart speakers have a sizable installed base [3]. Over 100 million people have used Conversica's short message and email interface Intelligent Virtual Assistants (IVAs) services in their companies.

Famous virtual assistants like Amazon Alexa and Google Assistant are typically cloud-based for maximum performance and data management. Many behavioral traces, including the user's voice activity history with extensive descriptions, can be saved in a VA ecosystem's remote cloud servers during this process.

The VAs story started in the 1910s, and the growth of technology has supported VAs' improvement. The application of Artificial Intelligence (AI) also was a turning point in VAs journey. Using AI to develop the VAs was a great jump to increase the VAs' capabilities. Currently, VAs use narrow AI with limited options. However, using general AI in the near future can be a revolution to improve the quality of VAs' services.

2. Backgrounds

2.1 Investigational years: 1910s: 1980s

In 1922, an interesting toy named Radio Rex was introduced that was the first voice-activated doll [4]. A toy in the dog shape would appear from its den the moment it was given a name.

Bell Labs introduced the "Audrey," which was an Automatic Digit Identification device in 1952. It took up a six-foot-high relay rack, used much power, had many wires, and had all of the issues that come with complicated vacuum-tube

electronics. Despite this, Audrey was able to discriminate between phonemes, which are the basic components of speech. However, it was restricted to precise digit identification by assigned speakers. As a result, it may be utilized for voice dialing. However, push-button dialing was generally less expensive and faster than pronouncing the digits in order [5].

Another early gadget that could carry out digital language identification was Shoebox voice-activated calculator that IBM developed. It was revealed to the public for the period of the 1962 Seattle World's Fair after its first market debut in 1961. This initial machine, which was built nearly twenty years earlier than the first Personal Computer made by IBM and debuted in 1981, was capable of detecting sixteen verbal phrases and the numbers 0 through 9.

ELIZA, the first Natural Language Processing (NLP) application or chatbot, was invented by MIT in the 1960s. ELIZA was designed in order to "show that man-machine interaction is essentially superficial" [6]. It applied configuration matching and replacement procedures in written reactions to simulate conversation, creating the impression that the machine understood what was being said.

The ELIZA was designed by professor Joseph Weizenbaum. During the ELIZA development period, Joseph's assistant has requested that he leave the room so that she and ELIZA can chat. Professor Weizenbaum later remarked, "I had no idea that brief exposures to a really simple computer software might cause serious delusional thinking in otherwise normal people [7]." The ELIZA impact, or the tendency to instinctively believe machine activities are equal to people's behaviors, was called after this. Anthropomorphizing is a phenomenon that occurs in human interactions with VAs.

When DARPA funded a five-year Speech Understanding Research effort at Carnegie Mellon in the 1970s, the goal was to reach a vocabulary of 1,000 words. Participants included IBM, Carnegie Mellon University (CMU), and Stanford Research Institute, among many others.

The result was "Harpy," a robot that could understand speech and knew around 1000 words, roughly equivalent to a three-year vocabulary. To reduce voice recognition failures, it could also analyze speech that followed pre-programmed vocabularies, pronunciations, and grammatical patterns to determine which word sequences made sense when spoken.

An improvement to the Shoebox was released in 1986 with the Tangora, a speech recognition typewriter. With a vocabulary of 20,000 words, it was able to anticipate the most likely outcome based on its information. Because of this, it was given the name "Fastest Typewriter. As part of its digital signal processing, IBM used a Hidden Markov model, which integrates statistics into the Using this strategy, you may anticipate which phonemes will follow a given phoneme. However, every speaker was responsible for training the typewriter to recognize his or her voice and halt in.

2.2 The beginning of intelligent virtual assistants: 1990s: Present

To compete for customers in the 1990s, companies such as IBM, Philips, and Lemont & Hauspie began integrating digital voice recognition into personal computers. The first smartphone introduced in 1994, the IBM Simon laid the groundwork for today's smart virtual assistant.

In 1997, Dragon's Biologically Talking application was able to detect and transcribe natural human speech at a pace of 100 words per minute, with no gaps between syllables. Biologically Talking is still accessible for download, and many doctors in the United States and the United Kingdom continue to use it to keep track of their medical records.

In 2001, Colloquies released Smarter Child on AIM and MSN Messenger, among other platforms. "Smarter Child" can play games and check the weather as well as seek up data. It can even speak with others to a certain extent, even if it is text.

Siri, which debuted on October 4, 2011, as an option of the iPhone 4S, was the first innovative digital VA to be placed on a smartphone [8, 9]. Siri was built when Apple Inc. purchased Siri Inc. in 2010, a spin-off of SRI International, a research institute financed by DARPA and the US Department of Defense [10]. It was created to make texting, making phone calls, checking the weather, and setting the alarm easier. In addition, it can now make restaurant recommendations, perform Internet searches, and offer driving directions.

Amazon debuted Alexa alongside the Echo in November 2014. Later, in April 2017, Amazon launched a facility that allows users to create conversational interfaces for any VA or interface.

From 2017 till 2021, all the VAs mentioned above have been developed, and there are the more intelligent VAs using for individuals and professional activities. The companies in different areas use the VAs to improve the quality of their decisions at different levels, from operation to the high management level.

3. Virtual assistants - method of interaction

There are different methods of interaction that VAs are using them. In the following, three of the popular VAs' interaction methods are mentioned.

- Text, including online chat, text messages, email, as well as other text-based modes of interaction, for instance, Conversica's IVAs for enterprise [11].

- Voice, for instance, with Siri on an iPhone (Apple products), Google Assistant on Android mobile smartphones, or Amazon Alexa [12] on the Amazon Echo device.

- By shooting and uploading photos, as Bixby on the Samsung Galaxy does.

Various VAs, such as Google Assistant, are available in several ways, including chat on the Google Allo and Google Messages apps and voice on Google Home smart speakers.

VAs use NLP to translate text input from the user or voice input into executable. Furthermore, many people use AI techniques, such as machine learning, to learn continuously. Some of these assistants, such as Google Assistant (which includes Google Lens) and Samsung Bixby, can also perform image processing to distinguish things in the image, allowing users to obtain better results from the images they have clicked.

The awake phrase could be used to activate a voice-activated assistant. These words, for example, are "OK Google," or "Hey Google," "Hey Siri," "Alexa," and "Hey Microsoft" [13]. However, there are increasing legal dangers associated with VAs as they become more popular [14].

4. Virtual assistants: Services

VAs can help with a wide range of tasks. These include the following [15].

- Set the alarm, construct to-do and shopping lists, and support data such as weather;

- Play TV shows, serials, and films on TVs, running from, e.g., Amazon Prime, YouTube;

- Play music from the platforms such as Pandora, YouTube, Spotify, and; podcasts, and read journals and audiobooks;

- Assist citizens in their dealings with the government;

- Conversational business; and

- Humans should be used to supplement and replace customer service [16]. For example, one study indicated that an automated online assistant reduced the burden of a human-staffed call center by 30% [17].

5. Virtual assistants - ethics implications

Generally, the consumers provide free data for the preparation and development of AI algorithms and VAs, which is often ethically disturbing. However, knowing how the applied intelligent models are developed using the consumers' data and information could be more ethically troubling.

Most VAs on the market use Artificial Neural Networks (ANNs) to train AI algorithms, requiring many labeled data. In order to understand the increase in microwork over the past decade, however, this information must be categorized by a human being in order to understand the increase in microwork over the past decade. However, a human being must categorize this information. People worldwide are paid to perform repetitive and incredibly simple tasks, such as listening and copying down voice input from a virtual assistant for a few cents. Because of the insecurity it creates and the lack of control, microwork has been called out as a problem. The average hourly wage was 1.38 dollars [18], with no healthcare, sick pay, retirement benefits, or minimum salary. This has led to a dispute between VAs and their designers over employment insecurity, and the AIs they propose are still human in a way that would be impossible without millions of human workers micromanaging them [19].

A VA provider's unencrypted access to voice commands raises privacy concerns since they can be shared with third parties and handled unlawfully or unexpectedly [20]. Along with language content, a user's style of expression and voice features can provide information about his or her biometric identification, personality attributes, physical and mental health condition, sex and gender, moods and emotions, and socioeconomic status and geographic origin [21].

6. Comparison of notable virtual assistants

Different AI products work as VA in the market. Each product has been designed to provide the assistant service for the specific product. There also are different brands of VAs, and behind them are genius companies who annually are investing billion dollars in this field. **Table 1** shows a shortlist of the most used VAs and their capabilities.

Virtual Assistant	Developer	IOT	Chromecast Integration	Smart Phone App
Alexa	Amazon	Yes	No	Yes
Alice	Yandex	Yes	No	Yes
AliGenie	Alibaba	Yes	No	Yes
Assistant	Speaktoit	No	No	Yes
Bixby	Samsung	No	No	Yes
BlackBerry Assistant	BlackBerry	No	No	Yes
Braina	Brain soft	No	No	Yes
Clova	Naver	Yes	No	Yes
Cortana	Microsoft	Yes	No	Yes
Duer	Baidu	N/A	N/A	N/A
Evi	Amazon	No	No	Yes
Google Assistant	Google	Yes	Yes	Yes
Google Now	Google	Yes	Yes	Yes
M	Facebook	N/A	N/A	N/A
Mycroft	Mycroft	Yes	Yes	Yes
SILVIA	Cognitive Code	No	No	Yes
Siri	Apple Inc.	Yes	No	Yes
Viv	Samsung	Yes	No	Yes
Xiaowei	Tencent	N/A	N/A	N/A
Celia	Huawei	Yes	No	Yes

Table 1.
Notable virtual assistants.

7. Virtual assistants – Financial importance

7.1 For persons

Digital experiences facilitated by VAs are one of the most encouraging end-user trends in recent years. Specialists predict that digital practices would gain a prestige equivalent to 'real' ones, if not more sought-after and valued [22]. The development is supported by frequent users and a significant increase in the number of virtual digital assistant users worldwide. The number of people who use digital VAs regularly was predicted to be approximately 1 billion in mid-2017 [23]. Furthermore, virtual digital assistant technology is no longer limited to smartphone apps but is also found in many different industries [24]. There will be a 34.9 percent CAGR for speech recognition technology from 2016 to 2024, surpassing a global market size of US$7.5 billion by 2024 [25] as a result of considerable R&D expenditures of enterprises across all sectors and increasing use of mobile devices in speech recognition technology [24].

According to an Ovum estimate, by 2021, the "native digital assistant installed base" will outnumber the global population, with 7.5 billion active speech AI-capable devices [25]. "Google Assistant would dominate the speech AI–capable device market with 23.3 percent market share by that time," according to Ovum, "followed by Samsung's Bixby (14.5 percent), Apple's Siri (13.1 percent), Amazon's Alexa (3.9 percent), and Microsoft's Cortana (2.3 percent)" [25].

5

Businesses in North America (such as Nuance Communications and IBM) are projected to dominate the sector over the next few years due to BYOD (Bring Your Own Device) and enterprise mobility business strategies. Furthermore, the growing demand for smartphone-assisted platforms will likely propel IVA's further growth in North America. On the other hand, even though it is smaller than the North American market [24], the intelligent VA sector in the Asia-Pacific area is predicted to expand at a 40 percent annual growth rate (above the world average) between 2016 and 2024, with its primary players located in India and China.

7.2 For companies

VAs should not be viewed solely as a tool for individuals, as they may have genuine economic value for businesses. A virtual assistant, for example, can serve as an always-available aide with encyclopedia knowledge. Furthermore, it can organize meetings, checking inventories, and verifying data. VAs, on the other hand, are so significant that their integration into small and medium-sized businesses is frequently a simple first step towards a more worldwide adaption and use of IoT. Small and medium-sized enterprises regard IoT technologies as critical technologies that are difficult, risky, or expensive to employ [26].

8. Virtual assistants: Protection

To demonstrate how audio commands can be directly integrated into music or spoken text, researchers from the University of California, Berkeley, published a study in May 2018. The publication showed that VAs could perform specified actions without the user's knowledge. The researchers altered audio files to eliminate the sound patterns that speech recognition algorithms are designed to recognize. Instead, noises were used to direct the system to dial numbers on the phone, launch webpages, or even move money [27]. Since 2016 [27], this has been a possibility, and it impacts Apple, Amazon, and Google devices [28].

Security and privacy concerns with IVAs are not limited to unwanted actions or voice recording. For example, when a person pretends to be someone else, he or she uses malevolent voice commands to gain illegal access to their home or garage, such as unlocking a smart door or shopping items online without their The system may have trouble distinguishing between similar sounds, even though some IVAs have a voice-training feature to prevent imitating. In addition, the system may be fooled into believing that the user is the real owner if a malicious individual has access [29] to an IVA-enabled device.

9. Virtual assistants: A new definition

From 2020 when the world faced the COVID-19 pandemic, and most people had to work remotely from home, the VA found the new definition. A human VA, also known as a virtual office assistant, is a self-employed person who works remotely from a home office to give clients professional administrative, technical, or creative (social) help [30]. Unless these indirect costs are included in the VA fees, clients are not liable for employee-related taxes and insurance or benefits because VAs are independent contractors rather than employees. They also avoid the logistical nightmare of providing additional office space, equipment, or supplies to a third party. A virtual assistant (VA) is a person who does a specific task for a client. The client pays

only for work, that is. VAs typically serve other small companies [31, 32], but they can also assist busy executives.

VAs use the Internet, email, phone-call conferences and online workplaces, as well as fax machines, to communicate and exchange data with each other There is also a growing use of Skype and Zoom, Slack, or Google Voice by virtual assistants (VAs Because the professionals in this field operate on contract, it is believed that they will work together for a long Ten years of office experience is required for executive assistants, office managers/supervisors, secretaries, paralegal assistants, legal secretaries, real estate assistants, and information technology.

Voice Over Internet Protocol (VOIP) services like Skype, Microsoft Teams, Google Meet, and Zoom have made it possible to have a virtual assistant (VA) answer the phone without the end user's knowledge in recent years, and VAs have made their way into many mainstream organizations. With today's technology, many firms may personalize their receptionists without having to pay for an additional receptionist.

A VA is a person or company who works remotely as an independent professional, supplying a wide range of products to businesses and customers. When it comes to the typical secretarial tasks such as website editing, social media marketing, and customer care, and data input and accounting (MYOB and QuickBooks), virtual assistants excel. In the virtual world, the industry has changed tremendously as more people join.

VAs come from various professional backgrounds, but the majority have at least a few years of experience working in the "real" (non-virtual) corporate sector or working online or remotely. The modern world is a place for VAs, where the next generation is increasingly relying on intelligent technology to improve their personal and professional lives.

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