POLITECNICO DI MILANO
School of Design - BV
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Graduation Thesis

# Studies on interaction between client and virtual assistant. An investigation on virtual assistants for Retail

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Dwan Ev ceremoniously soldered the final connection with gold. The eyes of a dozen television cameras watched him and the subether bore throughout the universe a dozen pictures of what he was doing.

He straightened and nodded to Dwar Reyn, then moved to a position beside the switch that would complete the contact when he threw it. The switch that would connect, all at once, all of the monster computing machines of all the populated planets in the universe — ninety-six billion planets — into the supercircuit that would connect them all into one supercalculator, one cybernetics machine that would combine all the knowledge of all the galaxies.

Dwar Reyn spoke briefly to the watching and listening trillions. Then after a moment's silence he said, "Now, Dwar Ev."

Dwar Ev threw the switch. There was a mighty hum, the surge of power from ninety-six billion planets. Lights flashed and quieted along the miles-long panel.

Dwar Ev stepped back and drew a deep breath. "The honor of asking the first question is yours, Dwar Reyn."

"Thank you," said Dwar Reyn. "It shall be a question which no single cybernetics machine has been able to answer."

He turned to face the machine. "Is there a God?"

The mighty voice answered without hesitation, without the clicking of a single relay.

"Yes, *now* there is a God."

Sudden fear flashed on the face of Dwar Ev. He leaped to grab the switch.

A bolt of lightning from the cloudless sky struck him down and fused the switch shut.

*Fredric Brown, "Answer"*

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# Introduction

Technologies are changing our world.
In the last years so many new technologies entered to our everyday life. We've got the new ways to produce, learn, discover our universe, and surely to communicate. To communicate between each other and between us and machines.
Paradoxically, as more and more advanced technologies become more and more *natural*, elegant and harmonically.
Technologies mimic the behavior of man and natural phenomena.
Since the era of Machines started, the way of communication has been changing a lot. After the electricity has come to our lives in the 19th century we've started to use wire telegraph and then telephone. Now we could transfer the voice information almost immediately in a quite good quality.
In the 20th century the first computes appeared. For these we've created the special ways, languages, to communicate them (or it's better to say *'to program'*). Ada Lovelace used the punch cards to make the machine solve the Bernoulli equation expressing the law of conservation of energy of a moving fluid.
The first working programmable computer (1941), the first programs for it, and (with certain reservations) the first high-level programming language *Planckalkul* were created by German engineer Konrad Zuse.
From the second half of the 20th century the *exponential growth* of computer development has begun.
Moore's law says that the observation that the number of transistors in a dense integrated circuit doubles approximately every two years. However we can say this low works even for all the computer industry. Indeed, let's look for the technologies appeared in the last 10 years:

2007 the first mobile processor Intel Atom was introduced by Intel
*2009 demonstration of quantum computer D-Wave One*
2010 the first personal voice assistant Siri by Apple
2012 SmartThings by SmartThings as the first not expensive Smart Home
2017 Google's AlphaGo AI wins three-match series against the world's best Go player.

Technologies have penetrated into our life, become part of it and changed many of its sides.
65% of children today will end up in careers that do not exist yet.
Today we came to the necessity of transformation of the retail according to the technical and technological evolution and to the expectation, attitudes and pattern of the behaviour of the customer.

There is a contradiction between rapid development of the technologies of artificial intelligence and a lack of research in the field of building of interaction between him and human being, as well as the need for its introduction into daily life.

An attempt to resolve these contradictions has determined the problem of our investigation.

The problem of this study is the lack of the schema and scenario of interaction between the Virtual Assistant and human being (customer). Actual problem of the interaction between customer and virtual assistant is coming from two already quite well-studied questions:

1) The interaction between shopping assistant and customer and
2) Interaction between human being and computer.

There problems were studied by J. Markoff, M. Pillan, R. Burke and others.
The purpose of our study is development of the schema and scenario of interaction between the Virtual Assistant and human being in the name of the customer.

**The objectives of our work are**

- Research of the case studies of the existing virtual assistants
- Collection and synthesis of data about structure and interaction with virtual assistants
- To allocate a number of features for creating a virtual assistant for retail

# Sintesi

Nell'ultimo decennio, lo sviluppo delle tecnologie dell'intelligenza artificiale è stato caratterizzato dai cambiamenti qualitativi e quantitativi globali. Inoltre, l'intelligenza artificiale sta entrando nella vita delle persone: semplifica la nostra routine, cambia le professioni, e favorisce la diffusione e l'accesso alle tecnologie in ogni settore. In particolare, l'intelligenza artificiale è utilizzata a supporto dei servizi di vendita e, tra le altre applicazioni, i chat-bot.

Nonostante sul mercato ci sia un gran numero di assistenti virtuali, molti sono ancora imperfetti, con punti di forza e di debolezza, che richiedono miglioramenti consistenti per essere ottimizzati dal punto di vista della loro fruizione.
L'analisi, la classificazione e la valutazione degli assistenti virtuali oggi esistenti costituisce a nostro parere un lavoro preliminare utile per dare un contributo allo sviluppo di un assistente virtuale efficace, facile da usare e utile per la vendita.

Questa tesi si pone come obiettivo lo studio dello stato dell'arte dei sistemi di intelligenza artificiale impiegati nei servizi di vendita online, per arrivare allo studio dei meccanismi e dei modi di interazione tra utenti e assistenti virtuale.

Grazie all'analisi degli assistenti esistenti, possiamo identificare i fattori che supportano la vendita virtuale, identificare diversi tipi di assistenti e le loro funzioni, e valutare le qualità delle interazioni dell'utente con gli assistenti virtuali nella vendita al dettaglio.
La ricerca ha come obiettivo finale, la produzione di conoscenze per la progettazione di un nuovo assistente virtuale basato sul configuratore virtuale 3D web-based di ELSE Corp.
La tesi riporta i risultati dell'indagine sullo stato dell'arte dei principali agenti oggi utilizzati nel web, e riporta il contesto progettuale di ELSE Corp.

# Abstract

In the last decade, the development of artificial intelligence technologies has been characterized by global qualitative and quantitative changes. Furthermore, artificial intelligence is entering people's lives: it simplifies our routine, changes professions, and promotes the dissemination and access to technology in every sector. In particular, artificial intelligence is used to support retail and, among other applications, chat-bots.

Despite the large number of virtual assistants on the market, many are still imperfect, with strengths and weaknesses, requiring substantial improvements to be optimized from the point of view of their usage.
The analysis, classification and evaluation of existing virtual assistants is, in our opinion, a preliminary work useful for contributing to the development of an effective virtual assistant, easy to use and useful for the sale.

This thesis aims to study the current state of artificial intelligence systems used in online sales services, to arrive at the study of the mechanisms and ways of interaction between users and virtual assistants.

By analyzing existing assistants, we can identify the factors that support virtual sales, identify different types of assistants and their functions, and evaluate the qualities of user interactions with virtual assistants in retail.

The final goal of the research is the production of knowledge for the design of a new virtual assistant based on the ELSE Corp. 3D web-based virtual configurator.
The thesis reports the results of the survey on the state of the art of the main agents currently used on the web, and reports the design context of ELSE Corp.

# 1.

# Virtual assistants and retail

# Artificial intelligence: new customer demands.

**Industry 4.0**

Now we're living in the era of the Industry 4.0. What does it mean?

The story of the industry had already three revolutions that preceded the industrial eras.

The first era was the Mechanisation Era. The machines used the power of water and steam to produce more.

The second was the Electricity Era. Now the assembly chains and electricity is using to produce. Mass production has started.

In the first two eras the hand work was using a lot anyway. Neither steam nor electricity could not replace the hands of workers.

But the third industrial revolution did it.

Now machines could almost think and react to real life situations in order to boost effectiveness and help to make the industry more incredible than ever before.

Starting from 2010 first the companies in Germany then outside of it began to step in. There was more virtualization and input from neighboring countries, so that effective work solutions could be created. Decentralization became a key component for the process, and ensuring that digital manufacturing would ultimately benefit from the new processing the most. This is the point where the internet of things became perfectly aligned with the industrial revolution and a sweet harmonious union was formed. [Bill McCabe, 2016]

Here the use of computers has begun. By now it was enough to write a program by machine. To produce a product we no longer needed the hands of the workers, but the intelligence of the engineers.

**4th Industrial Revolution**

The connected enterprise leads to the 4th industrial revolution. Connecting production facilities with the internet of things.

**3rd Industrial Revolution**

Combining IT and electronics allows for further automation of the production process

**2nd Industrial Revolution**

Mass production fuels the 2nd industrial revolution with the help of electrical power

**1st Industrial Revolution**

Introduction of mechanical production facilities supported by water and steam power

Industry 4.0 is a name for the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of things, cloud computing and cognitive computing.

Industry 4.0 creates what has been called a "smart factory". Within the modular structured smart factories, cyber-physical systems monitor physical processes, create a virtual copy of the physical world and make decentralized decisions. Over the Internet of Things, cyber-physical systems communicate and cooperate with each other and with humans in real time, and via the Internet of Services, both internal and cross-organizational services are offered and used by participants of the value chain.

*pic.1, The biggest impact of AI*

# Where AI will have the biggest impact
Insurance business functions with most to gain from investments

- Customer service, 28%
- IT, 20%
- Sales, 17%
- Marketing , 7%
- R&D, 6%
- Other, 22%
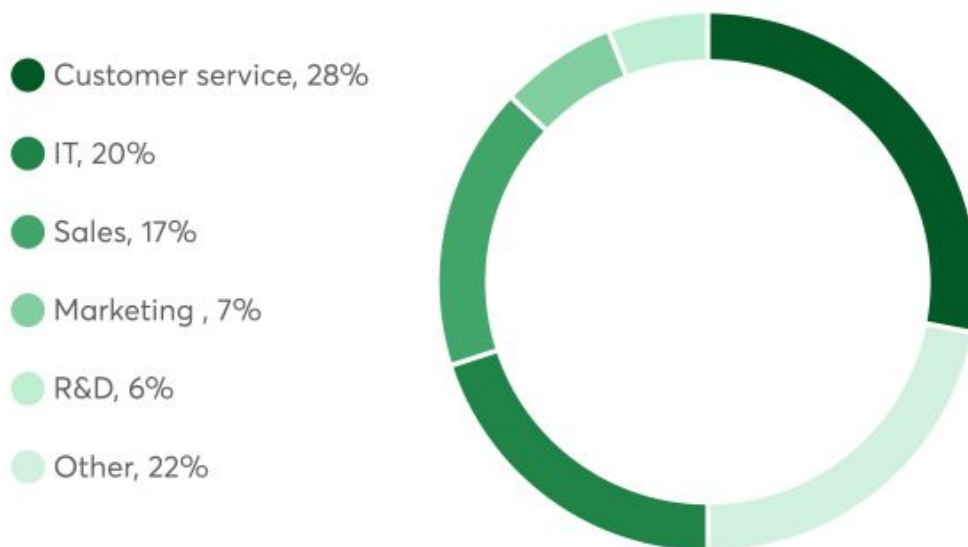
Source: Tata Consultancy Services

**"In the 2018-2020 45% of retailers plan to use artificial intelligence. Customer Experience/Unified Commerce Benchmark Survey"**
*Boston Retail Partners, 2017*


**"Annual worldwide AI revenue will grow from $643.7 million in 2016 to $36.8 billion by 2025"**
*Artificial Intelligent Market Forecasts. Tratica, 2016*


**"53% of customers will abandon an online purchase if they can't find a quick answer to their questions. AI powers presales services to educate buyers, minimizing purchasing errors and buyer's remorse"**
*How AI Will Transform Customer Service. Forrester, 2017*


**"70% of U.S. millennials appreciate a retailer using AI tech to show more interesting products"**
*Frontierless Retail. JWT Intelligence, 2016*


**"By 2019, about 40% of retailers will develop a customer experience architecture supported by AI, with such platforms providing up to a 30% conversion increase and a 25% revenue bump due to hypermicro personalization"**
*IDC Retail Insights. International Data Corporation, 2016*


**"Brands that create personalized experiences by integrating advanced digital technologies and proprietary data for customers are seeing revenue increase by 6% to 10%—two to three times faster than those who don't"**
*"Profiting From Personalization." Boston Consulting Group, 2017*

Bots rapidly enter to the market. For having the leader positions brands and sellers need to include virtual assistants in their applications for sales to get ahead.

The availability of many open source VA-frameworks will rapid spread in the near future. It will allow to sellers (including selling apps) to choose between ready and adopted frameworks for including to their systems of sales. They will choose the FW that are simple to implement to the enterprise and to use by customer, it should be enough "smart" and communicate naturally with its user.

In the next 2-3 years up to 50% of virtual assistants will use natural language interaction (both spoken and written ways).

In the future, retailers and brands will offer personal AI assistants that can change the shopping habits of millions of customers, use your friends to crowdsource ideas and check what suits you, before making recommendations, eBay's chief scientist Kira Radinsky told the room. In 2016, the company bought Radinsky's SalesPredict startup, which uses AI to observe and forecast human behaviour. "By combining data, artificial intelligence and your own details, an app can suggest things to buy while predicting new products for retailers," she explained.

For Daniel Murray, co-founder of fashion and lifestyle app Grabble, the problem is getting your app on to a shopper's phone. "No one downloads apps any more, but 89 per cent of all time spent on mobile is spent in apps, so something is wrong," Murray explained.

His solution? In-app apps, such as the brand stores in Asian social network WeChat. He warned, though, that "it is the duty of these walled-garden native apps to provide data. [Stephen Armstrong, 2018]

Still, the present situation seems to be a transitory one, far from achieving a steady order, and we are witnessing a tangle of different trends and contradictory phenomena.

REAL-TIME ENGAGEMENT Accustomed to the instant access of e-commerce, customers are looking for opportunities to skip the line and have direct communication channels to ask, troubleshoot and, of course, shop.

DIFFERENTIATED PERSONALIZATION Always on the move and constantly tethered, today's consumers shop where, when and how they please. They expect retailers to keep pace with their mobility and provide consistent personalization no matter where they're shopping.

RELEVANT RECOMMENDATIONS Customers are exchanging their personal data, like location, purchase history and day-today use, for the promise of progressively relevant experiences. Shoppers anticipate that retailers will offer them services and products that are needed in the moment, and change depending on why and how they're shopping.

LONG-TERM BRAND RELATIONSHIPS Frustrated with the hassle of re-engaging a retailer or resubmitting preferences, customers expect brands to compile personal shopper profiles that can recognize them across channels and build relationships that learn and progress over time.

VALUE-ORIENTED SHOPPING With convenience already a baseline shopping expectation, consumers are looking for retailers to improve their purchase confidence or empower their decision-making—which will reduce the amount of time spent later returning or exchanging products.

## Artificial Intelligence

Developments that preceded the emergence of artificial intelligence

In 1964 John McCarthy, a mathematician and computer scientist, coined the term 'artificial intelligence'. He started to develop the technologies to recreate human abilities. He believed that this project can be completed in just a decade.

The first tool enabled to perform digital speech recognition was the IBM Shoebox, presented to the general public during the 1962 Seattle World's Fair after its initial market launch in 1961. This early computer, developed almost 20 years before the introduction of the first IBM Personal Computer in 1981, was able to recognize 16 spoken words and the digits 0 to 9. The next milestone in the development of voice recognition technology was achieved in the 1970s at the Carnegie Mellon University in Pittsburgh, Pennsylvania with substantial support of the United States Department of Defense and its DARPA agency. Their tool "Harpy" mastered with about 1000 words the vocabulary of a three-year-old. About ten years later the same group of scientists developed a system that could not only analyze individual words but entire word sequences enabled by the Hidden Markov Model. Thus, the earliest virtual assistants, which applied speech recognition software were automated attendant and medical digital dictation software. In the 1990s digital speech recognition technology became a feature of the personal computer with Microsoft, IBM, Philips and Lernout & Hauspie fighting for customers. Much later the market launch of the first smartphone IBM Simon in 1994 laid the foundation for smart virtual assistants as we know them today. The first modern digital virtual assistant installed on a smartphone was Siri, which was introduced as a feature of the iPhone 4S on October 4, 2011. Apple Inc. developed Siri following the 2010 acquisition of Siri Inc., a spin-off of SRI International, which is a research institute financed by DARPA and the United States Department of Defense.

In the contemporary world virtual assistants are the integral part of our lives. In the 22 Million Amazon Echo Smart Speakers (powered by Amazon Alexa) were sold only in United States.

On the same time only 2% of iPhone users say that they use Siri only sometimes or rarely, but nearly everyone's tried it. Consumers however, might not be as excited. [Carolina Milanesi, 2016]

Obviously, despite the fact that artificial intelligence technologies are being actively introduced by corporations, these are not yet a perfect product.

Google and Amazon offer us a virtual assistant for (almost) every possible situation. While the startups as Nuance Nina and Mind by Interactive Media focus on the chatbots helping to the customer assistance and business processes.

Now the artificial intelligence is not just one of the millions of technologies we got. The artificial intelligence is the *megatrend* that is able to drive other trends. The AI is going to change our lives as a wheel, internal combustion engine, electricity and radio have done. But its driving impact is much more rapid, it is growing incredibly fast.

The AI is going to be the D-driver for the next even several decades of years that powers businesses and society [Daugherty, Wilson, 2018].

# Importance of virtual assistants from today and for the future

It's not a secret for anyone that the assortment of luxury brands is not fully sold, while the maximum amount of resources is spent for its creation, both human and material, many of which are far from ethics. In the case of a project like Else Corp, and its counterparts, the problem can be partially solved.
Such services as Virtual configurator also largely help to solve the problem of pollution and an overabundance of things, which quite corresponds to the ideal model of reasonable consumption and ethical production.

This transition from industry 3.0 to Industry 4.0 is marked by the use of many resources, but at the same time it optimizes most of the processes of our life: from individual requests (Virtual Assistants) to smart cities, from invisible things that will not be visible to an ordinary citizen, explicit, with which we interact day by day, such as Google Clips, equipped with AI.

As natural language processing continues to improve, chatbots will migrate to virtual personal assistants, able to act on behalf of the user in predictable situations.
In addition to the user benefits described above, the availability of ready-made bots will greatly accelerate adoption and use of bots in the production environment. There are chat rooms that automate access to existing business applications, integrate with these applications and extract information from them in response to simple requests. These bot trading platforms, which are aimed at the end user for both personal and business use, will be facilitated by the easily accessible open-source bot framework, such as the Microsoft Bot Framework. Such structures will allow developers to create bots without requiring a license toolkit. The availability of open source tools will lead to the creation of ready-made bots for the above-mentioned markets.

**AI is going to be like electricity or the internet — it's going to be foundational technology [on] which most things are built...It takes CRM, it takes all of this other stuff that we've been doing for so long and it makes it better than the sum of the parts.**
*Kyle Nel. Executive Director, Lowe's Innovation Labs*

By 2020, customers will manage 85% of their relationship with the enterprise without interacting with a human.[Gartner, 2011]

According to the 2017 US Mobile Consumer Report, while "more than half of consumers have yet to see a [chatbot]," 65% would be fully comfortable engaging with a company via chatbot. Consumers' feelings about chatbots are particularly

telling. Chatbots are relatively new to the retail scene, and more than half of consumers have yet to see one. Nonetheless, 83 percent of consumers say they would feel comfortable interacting with one, preferably to obtain information quickly and easily. Other reasons consumers are open to the idea of interacting with a chatbot are that chatbots seem less intrusive to them than dealing with customer service representatives, or because communicating with a chatbot feels more natural in this instant messenger age. That so many consumers are open to a technology they are completely unfamiliar with shows how pervasive mobile technology has become. A new mobile channel is par for the course for most consumers, who, in their hectic everyday lives, are constantly seeking the next big thing to simplify their lives.

Chatbots mean speed and simplicity for the consumer. They mean not having to interact with another person. They mean 24/7 customer service. For these benefits, consumers are willing to try something new.

[Vibes, 2017]

**Business benefits: operational excellence**

"We believe that AI can deliver business value through making better products, faster, cheaper processes and more insightful analysis."
David Harris. SVP of IT, Burberry

"By leveraging AI to liberate store managers to do what they do best, retail organizations can elevate their relationships with employees, with customers and with suppliers. Store operations will run more smoothly...and consumers will be drawn to a new, more customer focused in-store experience."
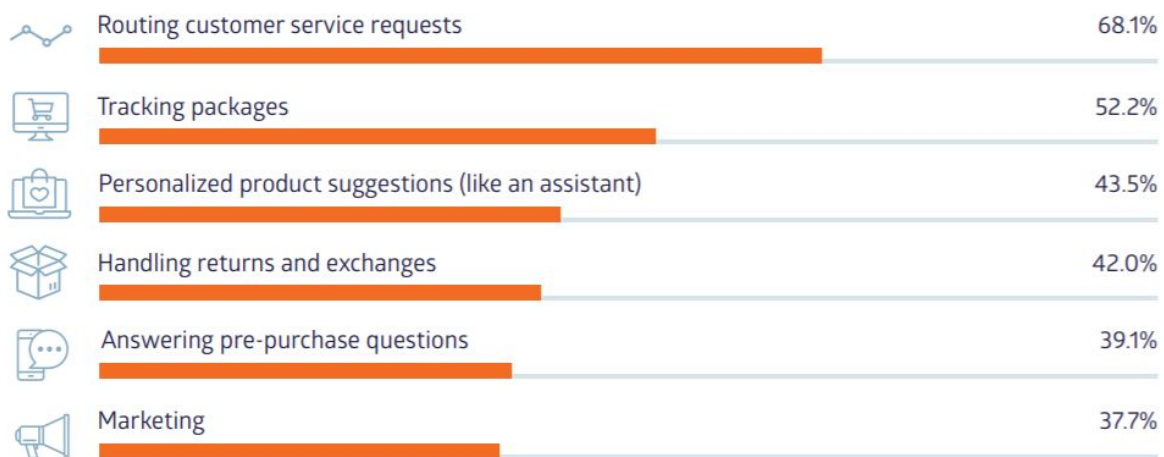Roman Stanek. CEO & Founder, GoodData

According to research, to date, more than 80% of off-line businesses suffer from competition from companies that have already begun to migrate to digital sales models, although more than half of them do not have a clear plan on how to properly implement digital technologies and build a new business model. model. According to the Harvard Business Review, which has not adapted to the new realities of business this year. A successful retail method is essentially impossible without the cooperation of fashion companies and technology giants such as Microsoft, which have recently helped the company more and more, building a strategy, using data analytics, applying artificial intelligence, cloud technologies and winning the love of the digital native generation

The market is filled with different models and the competition is growing - an affordable price will soon become a decisive factor for success, because technically the devices will be able to perform approximately the same functions. While the market for smart speakers in the US was occupied by Amazon, whose column Echo

occupies 70%, but in 2018 the situation may change. In particular, due to the appearance of Apple HomePod and various options from Samsung and, in particular, from LG. According to the report of Juniper Research, by 2022 smart speakers will appear in 55% of American families.

According to the report of Linc/BrandGarage the enterprises plan to use AI-powered conversational interfaces like messaging platforms or voice assistants for the following types of customer engagements:

*Fig.2, Types of customer engagements*

| | |
|---|---|
| Routing customer service requests | 68.1% |
| Tracking packages | 52.2% |
| Personalized product suggestions (like an assistant) | 43.5% |
| Handling returns and exchanges | 42.0% |
| Answering pre-purchase questions | 39.1% |
| Marketing | 37.7% |

**Retailer imperatives**

Captivate consumers. With a plethora of innovative competitors providing shoppers with immersive shopping experiences, traditional retailers need to engage customers in a personalized and relevant manner that is unique and inspiring across all touchpoints.

**Create exciting products** to drive continued interest, retailers need to differentiate their products and offer consumers compelling service and experiences. By integrating predictive analytics to gather more market insight, retailers can lead with innovation rather than react to change.

**Create insights from disparate data** faced with an onslaught of information from all aspects of their business from supply chain to stores to consumers, retailers need to filter through the noise to transform these disparate data sources into consumer-first strategies.

**Synchronize offline & online retail** digital and physical shopping channels typically operate under a different set of initiatives and approaches, but treating these channels as distinct business units adds friction to customers seeking a seamless shopping experience and leads to operational inefficiencies.

Empower flexible logistics networks in order to service a wider range of customer demands that are moving from mainstream to niche, retailers need to rethink their traditional supply chain in favor of adaptive and flexible ecosystems that can quickly respond to consumers' shifting behaviors.

Today's dynamic retail industry is built on a new covenant of data-driven retail experiences and heightened consumer expectations. But delivering a personalized shopping experience at scale—that is relevant and valuable—is no easy feat for retailers. As digital and physical purchasing channels blend together, the retailers that are able to innovate their retail channels will set themselves apart as leaders. Because they allow retailers to drive game-changing efficiencies and extract actionable analyses from their consumers, AI and cognitive services will be the tools of the trade in this new retail frontier. This accelerated operational pace will position brands as true customer service leaders—from the homepage to the sales floor, and back again.

*Fig.3, The most currently used platforms to support for customer service questions*

| Platform | Percentage |
|---|---|
| Email | 95.1% |
| Phone | 94.2% |
| Website Live Chat | 66.0% |
| Facebook Page | 57.3% |
| Twitter | 52.4% |
| Facebook Messenger | 32.0% |
| Text Messaging | 21.4% |
| In-app Live Chat | 14.6% |
| Other | 5.8% |
| Amazon Alexa | 1.9% |
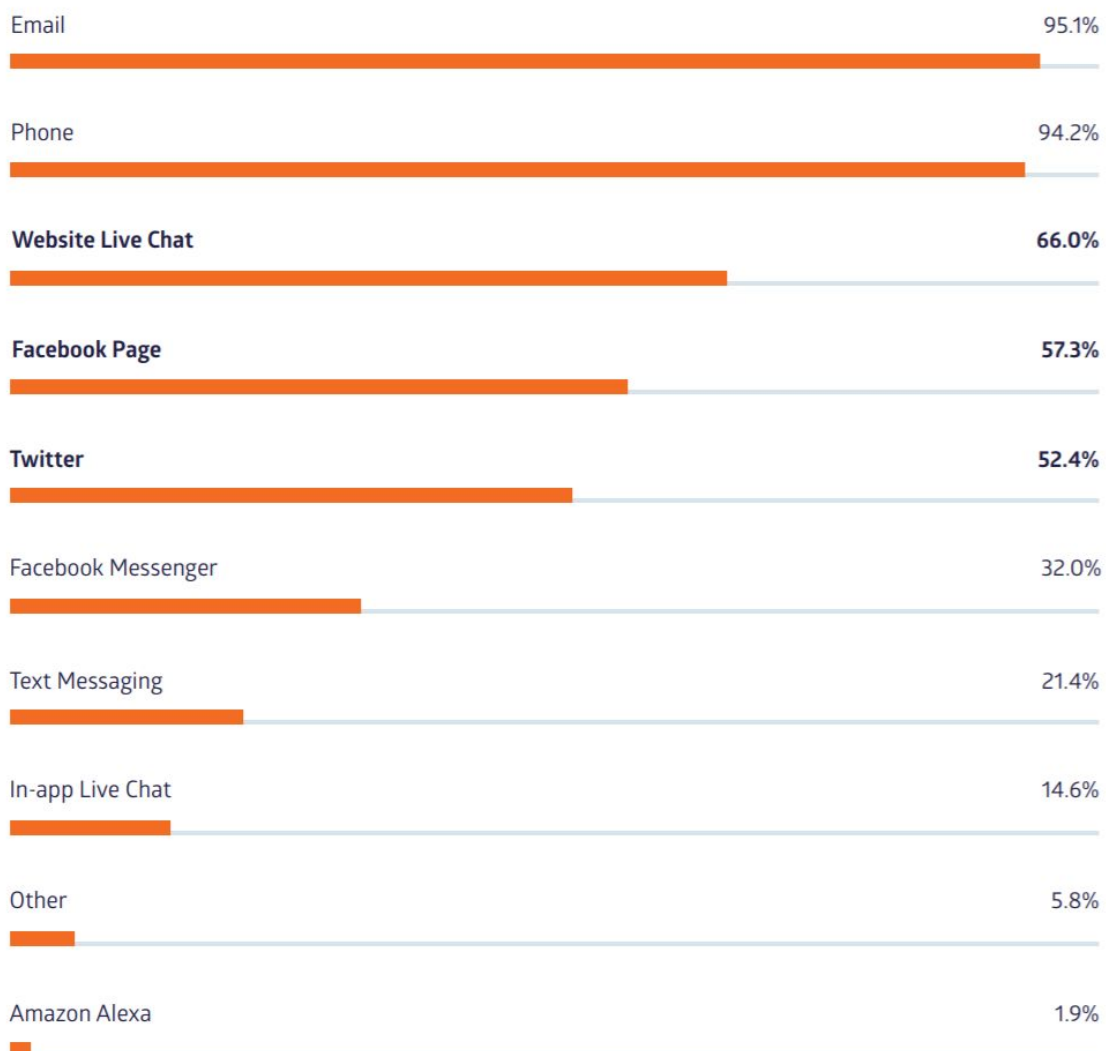
According to the report of Linc/BrandGarage the most currently used platforms to support for customer service questions are Email, phone and website lifechat. in-app live chat is used by less then 15% when AI-based solutions do not take even 1%.

Obviously, the market is moving ahead more slowly than users expect, but companies that offer AI-based solutions have every chance to enter the market leaders in the next few years, provided that the technology is continuously updated and customer experience.

Politecnico di Milano also developed a tool in collaboration with IBM, is intended to provide general support and cannot go into details of specific individual situations, for which you can use the chat with an operator, the counter by appointment and the request for assistance.
Conversations can also be used by third parties to improve the service or develop new features.

# Factors affecting virtual retail

The flow of Internet purchases in Europe alone has increased by more than 15% since 2016, and the number of customers in mobile applications has increased by 39%. Needless to say, that for the rhythm of buyers, most of which belongs to the generation of digital native, all brands are trying. To keep the client want and large retail networks, and online stores, and fashion brands luxury.
We see the result of this now: open at least your mail or social network, and you will find dozens of mailings from online stores that offer to buy that bag - moreover, based on your preferences - brand, form, price category and special offers.

- Ease of using of technology

Any technology is ease and comfortable to use either if it's using a natural ways to interact or if it's using a habitual interaction way.
All these factors caused a rapid initial growth of virtual sales.

- Less and less errors

The systems of artificial intelligence become more and more "intelligent". Before these were just the algorithms using some predefined settings and scenarios, answers. One of the last point of this approach was the bot of Microsoft. Already the second day after launch it became a "racist" and "misanthrope". This was the result of an incorrect approach to learning AI. The Bot analized the tweets of users, drawing conclusions according to its logic. The result is too much influence of a wide range of users in combination with excessively high speed of robot learning.
Newer AI are getting more intelligent using different technologies and being less influences by the wide range of users. They use more competitive principle and similar technologies.

- Trust in humanoid robots

Interesting fact from human psychology. The people tend to trust more to the machines looking like human. The human appearance inspires confidence even if the robot does some mistakes. And vice versa, even the machine making no errore does not cause a user's trust if it looks "different". (The same phenomenon is being using while producing the films: all the "good" robots look like human, the "bad" machines are less humanized).

- Ubiquitous distribution of robots

The greatest reason for trust in robots is the most natural: addiction. Human mind (as well as the animals' mind, here we are equil) trust in the things it sees everyday if

these are safe for it. That means more we see/interact safely the robots more we trust.

- Instant help

The possibility of using the real time solutions is really attractive to the consumer. Now, instead of waiting for a customer assistant, queue in the store or even for answering a call, customer may receive any information just asking their personal device.

For many years Karl McDorman has been studying the issues of human-machine interaction. He gave listeners test different voices, and then offered to fill in the tests and recorded the subconscious choices of the subjects. It turned out that men usually deliberately choose female voices, although subconsciously they do not show any obvious preferences. It is not excluded that in part this is a reflection of the expectations of society, according to which a man "must be a peasant" in the most diverse sense of the word. Women, on the contrary, consciously and unconsciously make a choice in favor of women's voices. [Мария Река, 2015] [Мария Река, 2017]

# Summary

Virtual assistants are the conversational interfaces whose aim is the most naturally possible help to their users (customers) according to the aims of the brand.
Bots are actively involved in our lives. In the world of Industry 4.0, in a world of growing technology, automation and robots, chatbots are a logical and integral part. Today, we can not imagine an iPhone without Siri, and Google Pixel without Google's assistant.
Tomorrow, virtual assistants will become an integral part of the shopping experience as a salesperson now.
The main characteristics of virtual assistants are artificial intelligence in the backend and the ability to understand the natural language (natural language understanding)
The growth and speed of artificial intelligence technologies are accelerating day by day. That is why creating a bot chat that will make the consumer happy is an important and priority. During digital transformation for large brands and companies, a virtual assistant will become an integral part of interaction with their client.

# 2.
# Case studies

# Methodology and tools

During the research the following methods were used:

- **Online research.**

Targeted search on brand sites. At the beginning, a research on the Internet (google, yandex ecc) has been done to find existing virtual assistants.

Targeted search on branded sites or resellers. After the formation of the scope of the research, the site of each service has been investigated in terms to find, highlight and analyze the features of each presented solution.

Casual discovery online. In some cases the information has been collected while surfing internet in free time.

- **Eventual research.**

Targeted and casual search during special events. The information about some technologies and solutions was collected during events such as ITForum, Milano (2017), VAR Group events (Roma, Milano, Rimini, 2017), Campus Party Milano (2017), Micam (2016, 2017, 2018).

Targeted search while demonstration of the product on Micam (2016, 2017, 2018).

- **Instore research.**

Targeted search while using the product. Launch of the demo version in collaboration with Therry Rabotin (Parabiago, 2016, 2017), Leonardi Milano (Milan, 2017) and FaceShoes (Bologna, 2017) and MadeForYou (Milan, 2018), new store opening in Russia (Voronezh, 2017).

Targeted research of the familiar technologies in the stores of Milan.

Our analysis allows us to assess the volume and status of the current situation in the industry of artificial intelligence and virtual assistants, and to conduct a deeper analysis of virtual assistants.

# Case studies: Virtual Assistants

Online service providers are getting ubiquitous and all-comprehensive; they increase their effectiveness offering real-time delivery of goods of any kind: from fresh foods to furniture, medicals, books and so on; they host industrial products but also offer e-commerce facilities to little-scale producers, artisans and manufacturers. Amazon and other companies refined the usability of their digital services so to make "natural" the online shopping processes, reducing the complexity of procedures for selection, data filling and payment, and making them almost automatic. New websites and mobile services appear everyday to support online sales, to allow product personalization, and promoting information and social activities related to the shopping experiences. [Pillan, 2016]

Many of them already offer the new solution for the customers. In the last 5-7 years many virtual assistants appears. So, using Amazon Alexa everybody can order any item from Amazon just using their voice.

26 billion. That's the number of intelligent, connected devices that, by 2020, are anticipated to be available with conversational virtual assistants.

We've been hearing a lot about chatbots recently, and with predictions that they will be responsible for managing 30% of customer experiences by 2022, it's no surprise commercial leaders are taking note.

Not just the B2C space that is expected to embrace conversational bots.
There are huge opportunities for bots in enterprise, particularly for internal operations. In fact, we can expect a 10% increase in staff productivity thanks to bots in the next two years, according to Gartner. Considering B2E bots are still at the early stages of adoption within the industry, this is a promising figure [].

According to the common trends, the new technologies do not appear from one center but appear from many spots on the same time. So, we've got many search engines, many social network and even many applications with the same functionality and even looking similar but that have been developed independently, not as the similarity of each other, but as competitors. The virtual assistants are being born in the same way.

Physical stores represent important economical and social resources for local environment, and we believe that ICTs can be employed to empower the quality of their business.  furthermore, as customers are already vastly employing digital

devices with respect to their shopping activities, little shops with local business should embrace the opportunities offered by technology so to better respond to users needs. [Pillan, 2016]

Here is the table of 32 the most well known virtual assistants.

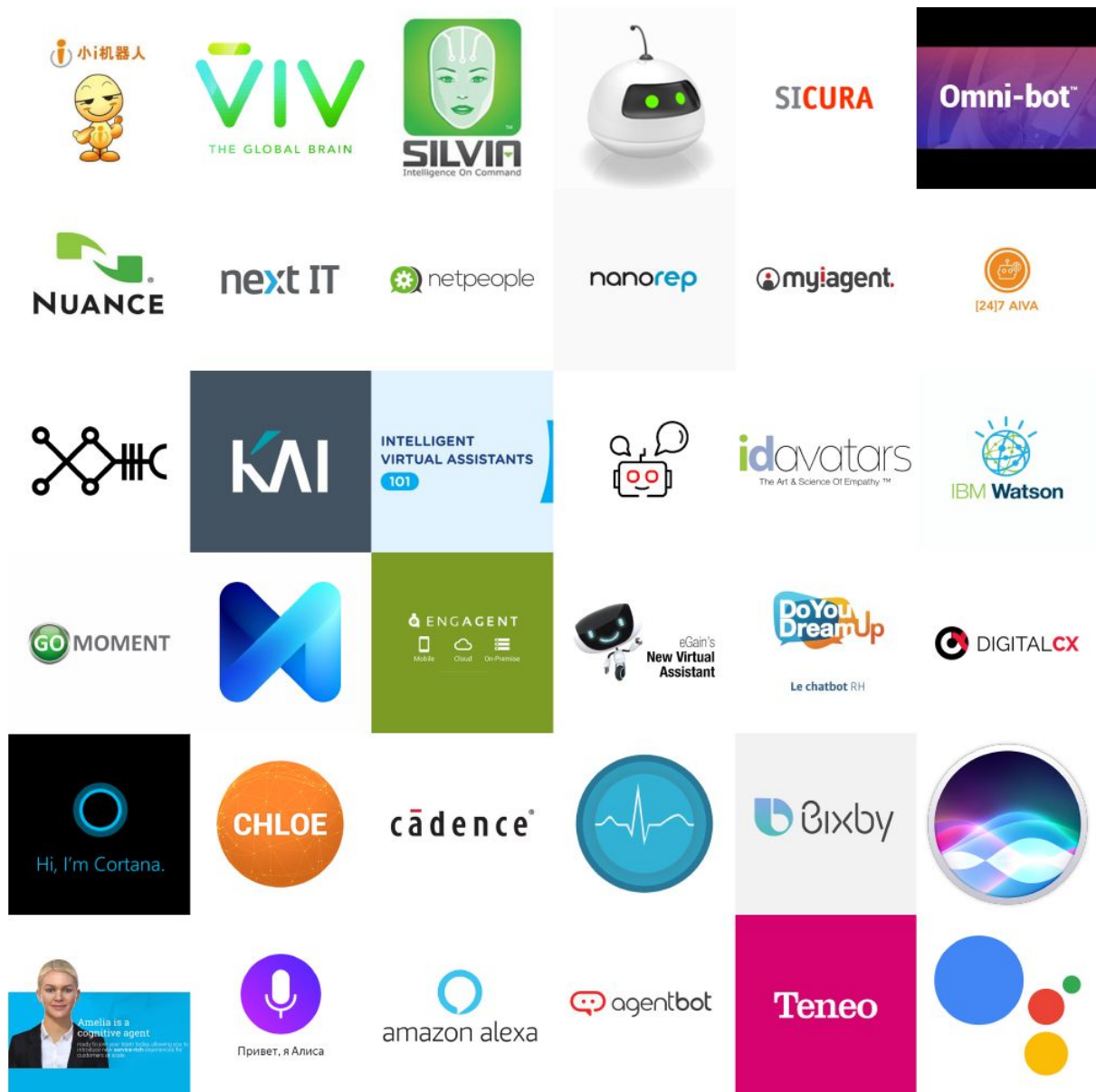*Fig.4, The most well-known virtual assistants*

*Table 1, 32 the most well known virtual assistants.*

| N | Name of product | Short description | Languages | Platforms | Company | Customers |
|---|---|---|---|---|---|---|
| 1 | **[24]7 Artificial Intelligence-Powered Virtual Agent (AIVA)** | [24]7.ai enables to create personalized customer experiences through various products such as Chat, Speech, Virtual Agents, Digital Chat Agents, Customer Journey Analytics, Active Share, Personalization and Predictive Search Bidding. | Chinese (simpli ed and traditional), Dutch, English, French, German, Italian, Japanese, Korean, Portuguese (Brazilian and European), Russian and Spanish | n/a | [24]7.ai | Adobe, KPMG, Mitsui and Neobpo |
| 2 | **AgentBot** | Aivo's product suite is composed of AgentBot, Live, Voice (phone VCA) and Help (knowledge base). AgentBot also understands customer intent and interacts with AI conversational engine technology across different text or voice channels | English, Portuguese and Spanish | Genesys, LivePerson, Oracle, Salesforce and Zendesk | Aivo | Facebook, Salesforce and Zendesk |
| 3 | **Teneo** | Artificial Solutions specializes in a form of AI known as natural-language interaction (NLI) technology, which allows people to speak to devices, applications, websites, bots and more, in a humanlike, intelligent and conversational manner. Teneo allows nonspecialists to build conversational VCAs that can be deployed in multiple languages, across multiple platforms and supporting multiple channels | 35 languages including Chinese, Danish, Dutch, English, French, German, Italian, Japanese, Portuguese, Russian, Spanish and Swedish | eGain, RightNow, Salesforce and SAP | Artificial Solutions | Accenture, Cognizant, cxpartners, KPMG, Mphasis, NIIT, SAP, Sapient, Software AG and Teleperformance |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | **V-Person** | Creative Virtual's suite is composed of virtual agent (V-Person), knowledge management (V-Portal) and business intelligence tools that are used by its customers to provide omnichannel engagement across web, mobile, social, SMS, contact center, service desk, live chat and IVR. | Arabic, Chinese (traditional and simpli ed), Danish, Dutch, English, Finnish, French, German, Indonesian, Italian, Latvian, Norwegian, Polish, Russian Spanish, Swedish and Turkish | n/a | Creative Virtual | Continuous Technologies International Ltd. (CTIL), Dimension Data, DXC, Fuji lm, Fujitsu, Genesys, Salmat, Serco, Stellar and Xerox |
| 5 | **DigitalCX** | CX Company enables its clients to design and deliver automated and personalized intelligent assistance at each step of the customer (decision) journey, across every digital channel and device. The platform runs on Microsoft Azure | Asturian, Bulgarian, Catalan, Chinese (simpli ed and traditional), Czech, Dutch, English, Estonian, German, Hungarian, Indonesian, Italian, Polish, Portuguese, Romanian, Russian (Latin alphabet), Slovak, Slovene, Spanish, Swedish, Turkish and Ukrainian | Microsoft Dynamics 365, Oracle, Salesforce, SAP, Siebel and Zendesk | CX Company | Microsoft |
| 6 | **Human+AI Customer Service platform** | Human+AI Customer Service platform combines human and machine intelligence, and uses technology that includes continuous AI learning, plus neural networks trained on historical customer service logs and email transcripts | Arabic, Danish, Dutch, English, French and Spanish | Salesforce Service Cloud and Zendesk | DigitalGeni us | Amazon, Nvidia, Salesforce and Zendesk |
| 7 | **NLP software** | DYDU provides native HTML user interfaces for integration into the websites of its customers that can be heavily customized through the back-of ce of the solution. | Dutch, English, Finnish, French, German, Italian, Polish, Portuguese, Romanian and Spanish | AB Tasty, EasyVista, Jira Software, Matcha, Microsoft, Odigo, Salesforce, ServiceNow, SharePoint and The Callback Company | Do You Dream Up (DYDU) | Acticall Group, CGI, Microsoft and Sopra Steria |

| 8 | **eGain Virtual Assistant** | eGain VA is powered by AI and leverages a knowledge base, including NLU and guided reasoning. It is uni ed with human-assisted touchpoints such as chat and co-browse for seamless customer journeys, and can be deployed on website, mobile, social channels and others | English (U.S. and U.K.), Italian, Japanese, Portuguese and Spanish | Microsoft Dynamics 365, Salesforce and SharePoint | eGain | Avaya, BT, Cameo, CDW, Cisco, KCOM, Presidio and Vodafone |
|---|---|---|---|---|---|---|
| 9 | **Ivy** | With its patent- pending technology and unique IBM Watson partnership, Ivy is trusted by hotels to automate 70% of large-scale customer interactions while improving key business metrics | English | Agilysys LMS, choiceADVANTAGE, Frontdesk Anywhere, Oracle Hospitality Opera, RoomKeyPMS, roomMaster, Springer-Miller, StarGuest and StayNTouch | Go Moment | IBM |
| 10 | **IBM Watson Conversation Service/Virtual Agent** | IBM Watson integrates NLU, dialogue, content and analytics into one tool for building and maintaining chatbots. It also offers deep industry expertise in healthcare, banking, automotive and retail. IBM Watson Virtual Agent supports providing customer assistance, providing a guided buying experience, and enhancing employee productivity through different channels. | Brazilian Portuguese, English, French, German, Italian and Spanish | Facebook Messenger, Salesforce, Slack and Twilio | IBM | Accenture, Capgemini, Cognitiva, Cognit, Deloitte, EY, KPMG, Infosys, SK Telecom and SoftBank |
| 11 | **MyiAgent** | MyiAgent VCA technology incorporates an easy-to-use code-free Authoring Console that enables the rapid | English | Email, IFTTT, Slack, SMS, Todoist and Wunderlist | i-Command | n/a |

| | | development of interactive conversational work ows | | | | |
|---|---|---|---|---|---|---|
| 12 | **Sophie Care, Dynamic DA (Digital Assistant), The Virtual Concierge** | iDAvatars (iDA) develops and markets avatars (virtual assistants) that integrate ML, real-time personalization, user engagement and informative/ educational content into a single solution that can improve the eficiency, effectiveness and outcomes of customer engagement and service. Spheres: healthcare, financial, education | English | Via API | iDAvatars | Affectiva, Amazon, Dell, Oracle, Unity and Watson |
| 13 | **netpeople** | Netpeople technology combines NLU, conversation and AI to deliver a humanlike experience that is smart and simple. | English and Japanese | Oracle and Salesforce | iNAGO | Clarion, Fujitsu Ten, NEC-PC, NNG and Nuance |
| 14 | | Inbenta has three main components — a semantic engine, an inference engine and a user interface — and uses NLP, semantic search and ML. This product is primarily used for the sales and customer service use cases, which involve online customer support and online sales. | Arabic, Basque, Catalan, Chinese, Czech, Danish, Dutch, English, Finnish, French, Galician, German, Greek, Hungarian, Indonesian, Italian, Japanese, Korean, Norwegian, Polish, Portuguese, Romanian, Russian, Spanish, Swedish, Thai and Turkish | Desk.com, Salesforce Service Cloud, ServiceNow and Zendesk | Inbenta | Bluleader, inContact/Nice, NTT Communications and TCS |
| 15 | **Intelligent Virtual Assistant (IVA)** | The IVA manages complex customer care interactions, such as account enrollments and updates, bill payments, branch/store locations, bene ts eligibility, reservations, loyalty and rewards programs and intelligent routing. Interactions uses | English (U.K. and U.S.), French, French (Canadian), German, Italian, Mandarin, Spanish and Spanish (U.S.) | Pegasystems and Salesforce | Interactions | n/a |

| | | success-based pricing, which allows its customers to only pay for mutually de ned successful transactions. | | | | |
|---|---|---|---|---|---|---|
| 16 | **Mind** | Mind solution includes an NLU engine followed by a semantic analyzer with statistical models (an ML approach), semantic rules and neural networks. Mind is also voice-integrated, with visual and text interaction, and has a deep linguistic technology for English, German, Italian, Portuguese and Spanish. | English, German, Italian, Portuguese and Spanish | Avaya, DBpedia, Cisco, Genesys, Google Maps, Google Voice, Nuance, SPARQL databases and IBM Watson | Interactive Media | Avaya, Cisco, Genesys, Google and Nuance |
| 17 | **Amelia** | Amelia enables to automate IT and business processes across a range of industries. It integrates full capabilities into a single platform, including supervised automated learning, contextual awareness, conversational intelligence, advanced analytics and smart work ow. | Danish, Dutch, English, French, German, Japanese, Norwegian, Spanish and Swedish | Active Directory, BMC Remedy, Cisco (Uni ed CCX), FreeSWITCH, Guidewire, HP Service Manager v9, IPcenter, LDAP, LivePerson/Li veEngage, MiContact Center Enterprise/So lidus, Microsoft, Oracle, Pegasystems , PeopleSoft, RSA, SAP, SAP (Concur), Salesforce, ServiceNow, Skype for Business, Zendesk, voice over IP | IPsoft | Accenture, Deloitte, McKinsey, NTT Communication s and PwC |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | (VoIP) and Wi-Fi management | | |
| 18 | **Kai** | Kai is a conversational AI platform, powers multimodal virtual assistants and bots with deep nancial domain expertise across mobile, web, messaging platforms and IoT devices. | Bahasa Indonesian, Cantonese, English and French | Avaya, Genesys, Infosys (Finacle), LiveBank and LivePerson | Kasisto | AWS, Deloitte and Mastercard |
| 19 | **Nanorep** | Nanorep is a digital self-service and chatbot solutions | English | NetSuite, Salesforce and Zendesk | LogMeIn | FIS, Tech Mahindra and WNS |
| 20 | **Alme** | Alme is a humanlike customer service experience, by combining the expertise of trained customer service agents with an in-depth knowledge of a business's assets. | More than 43 different languages through translation partner SDL | Abbott, Aetna, Alaska Airlines, Alight Solutions, Amtrak, Cable & Wireless Communications, Charter Communications, Dell, DSP Merrill Lynch, Intel, SWBC, U.S. Army and the U.S. Citizenship and Immigration Services | Next IT | Accenture, KTSL, Verint and Verizon |

| | | | | | | |
|---|---|---|---|---|---|---|
| 21 | **Sicura** | Sicura turns automated customer support into cognitive customer interaction. It also supports multiple channels, enabling end users to interact with the virtual assistant through their preferred channels. Sicura is primarily used for the use cases of customer service and sales, where it can provide upselling and cross-selling capabilities. The latest version of the platform allows customers to create conversational interfaces over databases and other external repositories of information. | Brazilian Portuguese, Chinese (simpli ed and traditional), Dutch, English, French, German, Italian, Japanese, Korean, Polish, Russian and Spanish | Amazon Alexa, Bing Search, Cisco Spark, Facebook Messenger, Google Assistant, Google Search, Lithium and Drupal, LivePerson, Oracle InQuira and Salesforce | noHold | Concentrix, Cisco, Google and Microsoft |
| 22 | **Nuance Nina** | Nina is able to deliver the right experience to the right customer across different channels based on customer intent, online behavior, past interactions and third-party data. Nina supports complex dialogs that allow it to understand the context of the conversation. A highly accurate NLU allows users to chat with Nina in a natural and humanlike way. Nina can ask a human coach for help that either selects the correct intent from the ones presented or escalates to a live agent. This information is then automatically logged, creating a continuous learning loop between the VCA and human-assisted conversations — for constant improvement | The Nina multichannel offering currently supports 19 languages (plus multiple variants of English, French, Portuguese and Spanish) | Alexa, Facebook, Facebook Messenger, Google Home, Twitter, Twitter Direct Messages, WeChat and other third-party systems such as Salesforce and Google Analytics | Nuance | Cola-Cola, Swedbank |

| 23 | **Engagent** | Hybrid Digital Support (HDS). Engagent utilizes AI and bot systems to handle customer engagements across websites, mobile apps, telephone and social channels. Engagent relies on its ML capabilities to understand different customer requests and offer the most appropriate responses in natural language | English, French, German, Italian, Portuguese and Spanish | Avaya, Genesys, Microsoft Dynamics and Salesforce | PAT Group | Advalia and Network Contact |
|----|----|----|----|----|----|----|
| 24 | **Omni bot** | Its goal is to fundamentally improve the way customers communicate with the brands they love. SmartAction's VCA product automates solutions across 12 industries and eight distinct solutions, including account authentication, roadside assistance, scheduling and rescheduling | English and Spanish | Salesforce, Microsoft Dynamics 365 and leading digital commerce and ERP systems | SmartAction | EPIC Connections, Genesys, inContact and PPT Solutions |
| 25 | | It provides hybrid bot technology for messaging experience at a massive scale for the travel and telecom industries. Servicefriend uses Hybrid Bot Architecture — an approach that offers Tier 1 enterprises the scalability of a bot with the intelligence, comprehension and empathy of a human. | English, French, German, Mandarin and Spanish | Amdocs, Facebook Messenger, GDS, iMessage, Intercom, Line, Oracle, Viber, WhatsApp and Zendesk | Servicefriend | Facebook and Viber |

| 26 | **ESP Platform** | ESP Platform has its own NLP engine supporting Slavic languages, characterized by in ected morphology and "free word order" grammar. Its use cases are centered on customer service, where the product is used to provide customer support during nonbusiness hours, and is also used for customer message categorization and automatic distribution. | Dutch, English, German, Polish, Portuguese, Romanian and Russian | Aurea CRM, Facebook Messenger, Microsoft Dynamics 365, Pivotal CRM, Slack, Skype and Skype for Business | Stanusch Technologi es | IBM |
|---|---|---|---|---|---|---|
| 27 | **Chloe** | Chloe relies on NLP and ML to build its training set. At a basic level, Chloe responds to questions for which answers can be found in structured or unstructured historical data. It uses ML to analyze the characteristics, sentiment and intent of the individual, provide contextual and personalized responses, and even trigger actions on the customer's behalf | English and Spanish | Also, Avaya, Cisco, Facebook, Gmail, Intercom, Magento, Neto, OpenHR, Salesforce, Shopify, WordPress LivePerson, Zendesk and Zoho | Sundown AI | Avaya and Zoho |
| 28 | **iBot** | iBot is a complete framework that includes knowledge representation, inference and prediction, ML (deep learning), semantic understanding, analysis and decision making, plus bot development architecture. It provides virtual/physical smart robots, a software as a service/platform as a service platform and multiple industrial solutions in various elds | Chinese (simpli ed and traditional) and English | n/a | Xiaoi | Avaya, Alibaba Cloud, Huawei Mobile Cloud, Jingdong Cloud, Nuance and Tencent |

| 29 | **Google Assistant** | Google Assistant is a virtual personal assistant developed by Google that is primarily available on mobile and smart home devices. Unlike Google Now, the Google Assistant can engage in two-way conversations. | English, French, German, Hindi, Indonesian, Italian, Japanese, Korean, Portuguese, Spanish | Android, Google Home, Android TV, Google Allo, iOS | Google | Lenovo, Sony, JBL, LG, Audi, Volvo, iRobot, LG, General Electric, D-Link |
|----|----|----|----|----|----|----|
| 30 | **Amazon Alexa** | Alexa Voice Service (AVS), a cloud-based voice service that provides APIs to interface with Alexa. Products built using AVS have access to Alexa's growing list of capabilities including all of the Alexa Skills. AVS provides cloud-based automatic speech recognition (ASR) and natural language understanding (NLU). | English, German, and Japanese | Amazon Echo, Fire TV, Fire HD, iOS, Android | Amazon | Lenovo, Acer, LG, BMW, Ford, General Electric, HP... |
| 31 | **Cortana** | Cortana can set reminders, recognize natural voice without the requirement for keyboard input, and answer questions using information from the Bing search engine | English, Chinese (Mandarin), French, German, Italian, Japanese, Brazilian, Portuguese, Spanish | Windows 10 Windows 10 Mobile Windows Phone 8.1 Harman Kardon Invoke Microsoft Band 2 Microsoft Band Android Xbox One Skype[5] iOS[6] Cyanogen OS Windows Mixed Reality Amazon Alexa[7] | Microsoft | |

| 32 | | Siri uses voice queries and a natural language user interface to attempt to answer questions, make recommendations, and perform actions by delegating requests to a set of Internet services. The software adapts to users' individual language usages, searches, and preferences, with continuing use. Returned results are individualized. | English, Arabic, Chinese (Cantonese, Mandarin), Danish, Dutch, Finnish, French, German, Hebrew, Italian, Japanese, Korean, Malay, Norwegian, Portuguese, Russian, Spanish, Swedish, Thai, Turkish | | | |
|---|---|---|---|---|---|---|
| | **Siri** | | | | Apple | |

The table represents the most promising solutions in the fields of finance, healthcare, telecommunications, travels, retail etc.
For every solution there are the name of the solution, a short description, supported languages, possible platforms of integration, the name of company that produced the bot and the most important customers of the product.

## Channels and methods of interaction

Amazon and other companies refined the usability of their digital services so to make "natural" the online shopping processes, reducing the complexity of procedures for selection, data filling and payment, and making them almost automatic [Pillan, M. (2016].

The availability of multiple open-source bot frameworks will lead to a proliferation of readily available chatbots that can be used in the business.

Chatbots can combine steps in a process to make a somewhat complex sequence of events a simple request. This request can be made in English or, if supported, the user's native language.

Currently, most implementations are being done by SaaS vendors themselves, because customers and the partner ecosystem are at a nascent stage.

Chatbots and event-driven programming models allow enterprise development teams to permanently change for the better the way that employees interact with enterprise systems.

According to Gartner: **Virtual Assistant (VA)** is a conversational, computer-generated character that simulates a conversation to deliver voice- or text-based information to a user via a Web, kiosk or mobile interface. A VA incorporates natural-language processing, dialogue control, domain knowledge and a visual appearance (such as photos or animation) that changes according to the content and context of the dialogue. The primary interaction methods are text-to-text, text-to-speech, speech-to-text and speech-to-speech. [Gartner, 2018]

All the virtual assistants have conversation interface. It means the interface between user and program is built in format of conversation. For every single request user receives answer in format defined by the scenario of the program. In this case, it is not necessary that the conversation should take place in the form of a dialogue. The response can contain images, videos, actions of third party devices and programs ecc. It is important only that the conversation has the structure question-answer.

There are several basic types of User interface (machine-user interface):
-Command line interface
-Graphical user interface (GUI)
-SILK-interface (from speech - speech, image - image, language - language, knowledge - knowledge)
-Gesture interface
Before the era of Industry 4.0 the program used one type of interface, less often - their combinations. Each type of interface type of interface implies processing one type of signal.
However, with the advent of the era 4.0, the ways people interact with the application should change.

Virtual assistants make work via:
1) Text (online chat), especially in an instant messaging app or other app
2) Voice, for example with Amazon Alexa on the Amazon Echo device, or Siri on an iPhone
3) By taking and/or uploading images, as in the case of Samsung Bixby on the Samsung Galaxy S8
Some virtual assistants are accessible via multiple methods, such as Google Assistant via chat on the Google Allo app and via voice on Google Home smart speakers.

Virtual assistants use natural language processing (NLP) to match user text or voice input to executable commands. Many continually learn using artificial intelligence techniques including machine learning. To activate a virtual assistant using the voice, a wake word might be used. This is a word or groups of words such as "Alexa" or "OK Google"

**Voice-powered interactions**
"Voice-powered interactions with devices are likely to be a defining characteristic of computing over the course of the next decade."
*Siri co-creator Adam Cheyer*

**NLP**

Natural Language Processing (NLP) is an Artificial Intelligence (AI) technology that gives software the ability to understand language as we humans speak it. The virtual assistant software has to understand the intent of a question, not just the words. It will also have to understand the context of the conversation, continuing the interaction as a flow instead of reacting to separate, standalone questions. This is far harder than it appears and only the advances in AI have made it possible. Natural language search can be used to find answers and the software would understand it. Users can converse with chatbots just like they would another human and similarly get answers that a human would have provided. It is becoming harder and harder to differentiate the chat bots from human agents, which is a good thing. This allows companies to deploy virtual agents to take care of the initial customer touch points allowing agents to take on more complex and challenging issues.

Natural language processing is the ability of machines to map a spoken or written input to an intent. Most of the available virtual assistants now support the use of English languages or just one language if the country of development.

Virtual Assistants use NLP to recognize intents of customer requests. NLP implementations usually comprise an engine that processes customer requests using an assortment of algorithms to parse and understand the words and phrases in a customer's request. An NLP engine's processing is guided by customizable and/or configurable deployment-specific mechanisms such as language models, grammars, and rules. These mechanisms accommodate the vocabularies of a deployment's business, products, and customers.

Virtual assistants use machine learning technology to match actual customer requests with anticipated customer requests and then to select the content or execute the logic associated with the anticipated requests. (Machine learning algorithms learn from and then make predictions on data. Algorithms learn from

training. Analysts/scientists train them with sample, example, or typical deployment-specific input then with feedback or supervision on correct and incorrect predictions. A trained algorithm is a deployment-specific machine learning model. The accuracy of models can improve with additional and continuing training. Some machine learning implementations are self-learning.[Greenhill Analysis, Virtual Assistant Update, 2017]

An NLP engine based on using semantic, machine learning (ML) or neural networks, or a mix of the two in a hybrid system. NLP has advanced tremendously by allowing a computer or service to answer conversational, information-centered queries. This is, in turn, helping to advance the natural-language question answering (NLQA) system used for evolving from search options to zeroing in on the exact answer.[Gartner]

The biggest projects currently support some different languages as well (for example Siri of Apple supports English, Russian, French, German, Japanese, Korean, Chinese, Italian, Spanish, Dutch, Thai, Portuguese, Norwegian Bukmol, Danish, Turkish, Swedish, Arabic, Finnish, Malay and Hebrew).

According to the general analysis of case studies and methods of interaction there was created the **General schema of the principles of Conversational Interfaces' work**.

*Fig.5, Principles of Conversational interfaces' work*
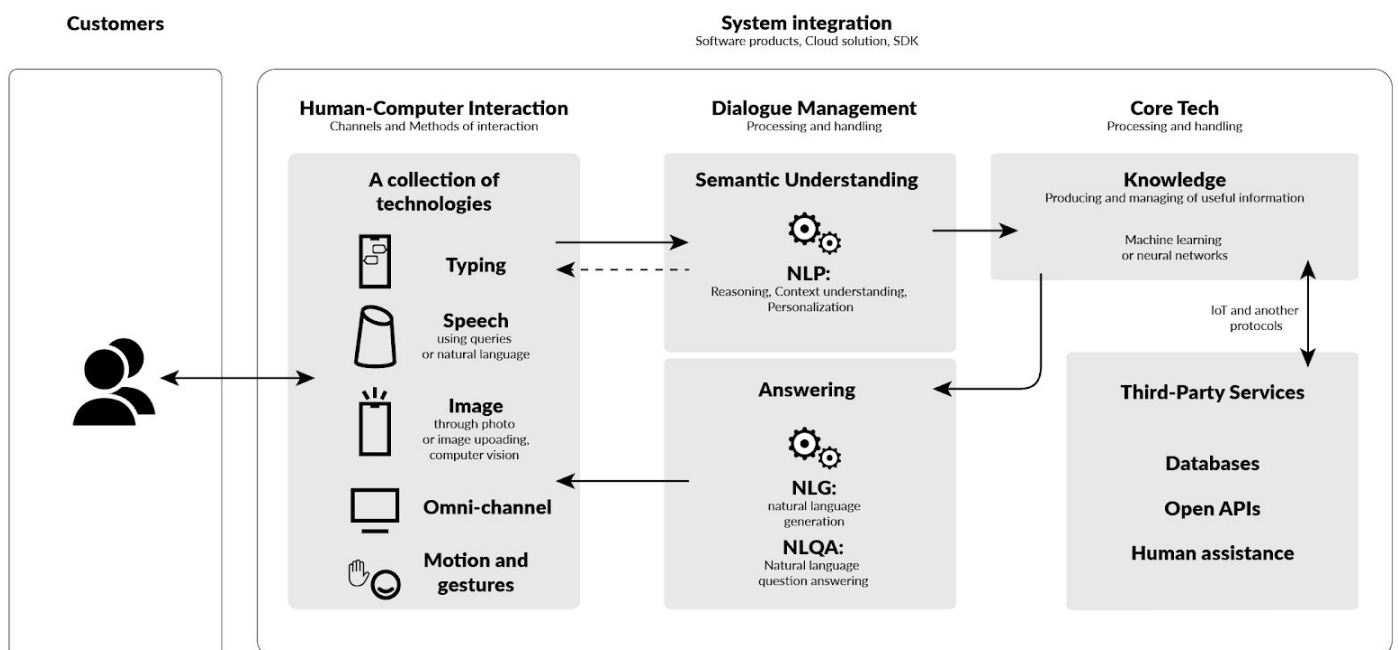
As a result of the analysis of more than thirty case studies, the work of the conversational interface was compiled. This scheme includes the basic parameters specific to the CI. The system of interaction includes three internal blocks:

- **Human-Computer Interaction** is the part with which a person interacts directly. It includes the channels and Methods of interaction between customer and bot such as typing, speech, motion or gesture and other types of technologies can be used for information exchange.
- **Dialogue Management** includes two following modules. The module of semantic understanding elaborates the information coming from the user and transforming it into data suitable for further processing. Here the **Natural language processing** can be used. The second module is generating the answers for customer. It uses the technologies of **Natural language generation** and **Natural language question answering** with the purpose of generating the most convenient response to customers request using the data coming from the third block:
- **Core Tech block** is the back-end part responsible for processing and handling of the data exchange between user, bot and third-party services. The Core tech block can use the neural networks and the technologies of machine learning in order to elaborate the data.

Except for the three main parts that are mandatory in each bot, there is a fourth part, varying from case to case:

- **Third-party services** can include databases, open APIs and even human resources, use cloud technologies, IoT and much more. But they are not the rule and the obligatory part for building a bot.

Using the data obtained in the analysis of case studies and the creation of the General schema, an in-depth analysis of the cadgy type of the assistant (on the example of one of the sample)
Dialogflow sends this information to your webhook, which subsequently fetches the data needed (per your development). Your webhook parses that data, determines how it would like to respond, and sends it back to Dialogflow

**Subjective analysis of the Virtual Assistants**

The assistants we review can be divided to 'Personal' and 'Customer'. First let's see what is Virtual assistant.

# Classifications of the Virtual Assistants

According to the areas of activity the virtual assistants were classified into twelve macro groups: Banking, Finances, Telecommunications, Healthcare, Manufacturing, Retail, Media and entertainment, Utilities, Consulting, Education, Government.

*Table 2, Classification of Virtual Assistants.*

| N | Name of product | Banking | Finances | Telecommunications | Healthcare | Travel and Hospitality | Manufacturing | Retail | Media and Entertainment | Utilities | Consulting | Education | Government |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **[24]7 Artificial Intelligence-Powered Virtual Agent (AIVA)** | | X | X | X | X | | X | | | | X | |
| 2 | **AgentBot** | X | | X | | X | | | X | X | | | X |
| 3 | **Teneo** | X | X | X | | | X | | | | X | | |
| 4 | **V-Person** | | X | | | X | | X | | | | | |
| 5 | **DigitalCX** | | X | | | | | X | | X | | | |
| 6 | **Human+AI Customer Service platform** | | | | | X | | X | | | | | |
| 7 | **NLP software** | X | X | | | | | | | X | | | |
| 8 | **eGain Virtual Assistant** | X | X | X | X | | | X | | | | | |
| 9 | **Ivy** | | | | | X | | | | | | | |
| 10 | **IBM Watson Conversation Service/Virtual Agent** | | X | X | | | | | X | X | | | |
| 11 | **MyiAgent** | | X | | X | X | | X | | | X | | |
| 12 | **Sophie Care, Dynamic DA (Digital Assistant), The Virtual Concierge** | X | X | | X | X | | | | | | X | |
| 13 | **netpeople** | | | | | | X | X | | | X | | |
| 14 | *Inbenta* | | | | | | | | | | | | |
| 15 | **Intelligent Virtual Assistant (IVA)** | | X | X | | X | | X | | X | | | |
| 16 | **Mind** | | X | X | | | | | | | | | X |
| 17 | **Amelia** | X | X | | X | | | | | | | | X |
| 18 | **Kai** | X | | | | | | | | | | | |
| 19 | **Nanorep** | | X | X | | X | | X | | | | | |

| # | Name | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | **Alme** |  | X |  | X | X |  |  | X |  | X |
| 21 | **Sicura** |  | X | X |  |  |  |  |  |  |  |
| 22 | **Nuance Nina** |  | X | X | X | X |  | X |  |  |  |
| 23 | **Engagent** | X | X | X |  |  | X |  |  |  |  |
| 24 | **Omni bot** |  | X |  | X | X |  |  | X |  |  |
| 25 | *Servicefriend* |  | X | X |  | X |  |  |  |  |  |
| 26 | **ESP Platform** | X | X | X | X |  |  |  |  |  |  |
| 27 | **Chloe** |  | X |  |  |  | X |  | X |  |  |
| 28 | **iBot** |  | X |  |  |  | X |  |  |  |  |
| 29 | **Google Assistant** |  |  |  | X | X |  | X | X | X |  |
| 30 | **Amazon Alexa** |  |  |  | X |  |  | X | X |  | X |
| 31 | **Cortana** |  |  | X |  |  |  | X | X |  | X |
| 32 | **Siri** |  |  | X |  |  |  | X | X |  | X |

## Functions of the Virtual Assistants

Virtual Assistants can also be classified by content-oriented functions as

- **Education**: helps to learn new information related to the service and product

- **Support**: Virtual Assistant helps to solve current problems and issues with a service or product

- **Instructions**: Virtual Assistant gives direct instructions to the user to solve issues or thain the usage of the product.

- **Catalogue**: Virtual Assistant helps to find and sort the items

- **Control**: Virtual Assistant helps manage the product or service

- **Entertainment**: user receives entertaining content with help of the Virtual Assistant

- **Planning:** user can control the schedules, timetable and plan their time within third party calendar apps or with integrated functionality of assistant.

# VPA and VCA

By functionality, the assistants can be divided into two large groups:

- **Virtual Personal assistants (VPA)**
- **Virtual Customer assistant (VCA)**

So what is the difference between Virtual Personal assistants and Virtual Customer assistant?

## Virtual personal assistants or VPA

**Virtual Personal assistants** is a *task-oriented* conversational platforms based on the technologies of artificial intelligence that helps to its user to do ar to simplify routines as search in internet, working with elements of smart home, set timers ecc.

Given the types of requests to virtual assistants Virtual Personal assistants have to have access to the internet to be able to get full and qualitative answers.

The biggest and well-known of Virtual Personal Assistants (Top four):

- Siri by Apple
- Google assistant by Google
- Alexa by Amazon
- Cortana by Microsoft

By now all these assistants have their own devices available. In addition, they are also available in the application format for a smartphone or computer. It is important to note that their functionality varies from device to device according to available functions of device and the permissions of the producer.

Alexa, Cortana, Siri and Google Assistant all work in similar ways, but there are protocol and data privacy intricacies involved when going from assistant to assistant.

When you activate one of the assistants, your request is immediately packaged up and sent to the servers owned by the company of your respective device. *(see pic. 3)* This is why, if you have a poor network connection, your virtual assistant might be slow.

**How people are using virtual personal assistants.**

As retailers adjust to a mobile-first world, technology is accelerating the pace of channel change. Consumers are entering an era of intuitive retail, where commerce is spoken and may soon even be worn in clothing, or embedded into bodies. And experience culture continues to challenge retail's brick-and-mortar foundations.

According to Transcendent retail research[] and Voicebot.ai[], users use virtual assistants mainly to request general information (such as time) information. Also to use the mobile functions: set the alarm or timer, make a call etc. But except that there is another important aspect. By now people are no longer afraid to buy through virtual assistants. On the research we see that we really use it already so much to order food or other products, to find and buy music or TV series. (Pic 2, pic. 3)

*Fig. 6, Digital home assistants activities*
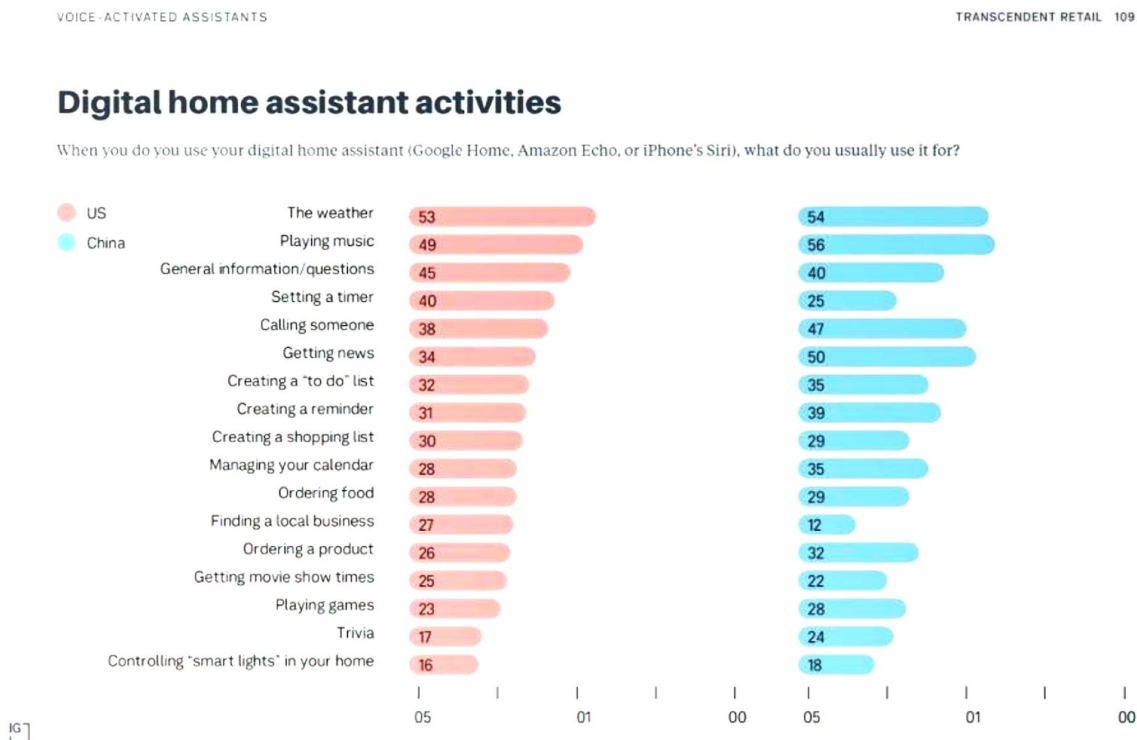


*Transcendent Retail—an Innovation Group report created in partnership with WWD, the leading fashion, beauty and retail authority—explores a retail landscape in which retail has transcended all its traditional boundaries.*

Google Assistant Apps by Category - December 2017
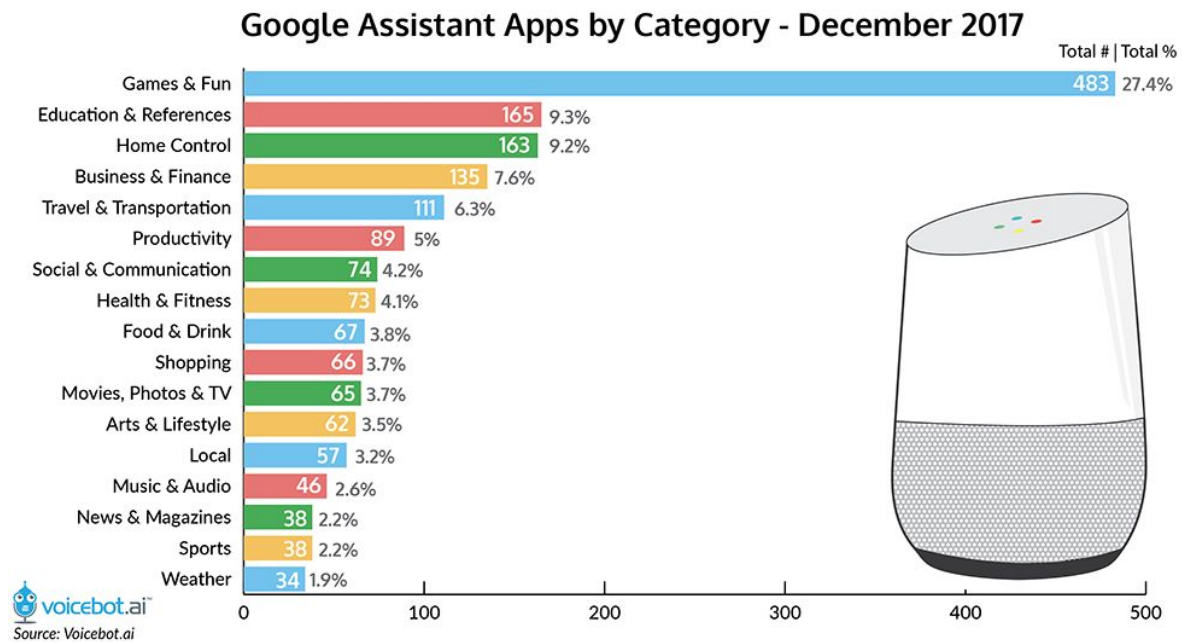
**Not All Google Assistants or Alexas are Equal**

It's worth noting virtual assistants may act differently depending on which device you're using them on. For instance, asking Google Assistant a question on your Google Home, Pixel XL or iPhone won't necessarily give you the same answers. Since Google Home doesn't have a screen, it can't show you photos of your cat (unless it's synced to your Chromecast or Android TV).

Similarly, your Amazon Dash Wand can't do everything your Echo does. They both use Alexa to fulfill requests, but the Dash Wand can't play music, set timers or tell you about your day.

Also, the way you access these virtual assistants isn't the same. For example, the Google Assistant app needs to be open on your iPhone to hear it's wake word. Similarly, on Amazon Tap, Alexa is accessed via button press rather than voice prompt.

**How Are These Virtual Assistants Different?**

One of the big differences lies in *where all the information is stored and how it's utilized*. Google's, Apple's, and Amazon's privacy policies explicitly say what information of yours is being used, why, and how it's being kept safe. In the moment, you don't think about the fact that your voice or shopping order is being sent up to a corporation's servers — it's vital that companies are transparent about their storage and use of information.

Upon arrival, the words and tone of your request are analyzed by an algorithm, which are then matched with a command that it thinks you asked. Essentially it's saying "we're eighty-five percent sure you asked this question," which is why you don't always get the answer you were looking for. If the algorithm isn't certain enough, it may ask "did you mean blank?" and give you its best guess as to what you wanted. Or it could say "I'm sorry I can't do that yet."

While the algorithm is analyzing the question, your phone or smart speaker is trying to figure out if it can handle the command without needing information from the server. For example, a request like "Can you pause the music?" is simple; if you want the assistant to translate a phrase from Italian to English, that's more complicated. Assuming your request is more complicated than a local command, your device will communicate back to the server and continue cross-checking your question to make sure it knows what you're asking.

Finally, your request is answered. If you asked your assistant for the answer to a trivial question, it will find that answer from the web (Google, Bing, etc.) and push the response back to your device. If you asked your Echo to turn on your smart lights, a signal will be sent to them via wi-fi, and they will turn on. The complexity is in relation to the speed of task fulfillment and understanding what you want on the first try. Once the assistant knows what it needs to do, that's a basic process of tapping into a server, third-party computer, or other electronic device.

For the following analysis we have chosen Google Assistant that seems us more improved.

# Google Assistant

**! Make Google do it**

**Languages:** English, French, German, Hindi, Indonesian, Italian, Japanese, Korean, Portuguese, Spanish

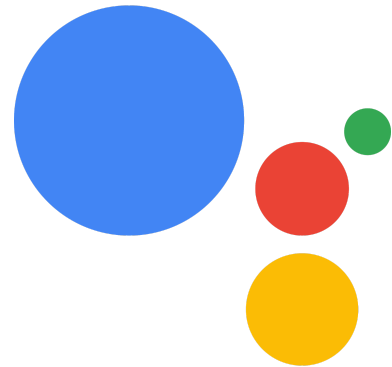**Available platforms:** Android, Google Home, Android TV, Google Allo, iOS

**Methods of interaction:** Typing, Speech.

**Estimated number of current users:** over 400 million devices

**May 2016**

## Short review

Google's smart assistant, Google Assistant, started to pop up everywhere in 2017. Google Assistant is developed by Google that is primarily available on mobile and smart home devices. Unlike Google Now, the Google Assistant can engage in two-way conversations. It's in Google Home and pretty much every new Android smartphone and Android Wear 2.0 device. There's also an iOS app, as well. The big draw of Google Assistant is that it's tied to Google; when you ask it a question, the request goes through similar algorithms and massive servers as Amazon's Alexa, but it's able to search Google's entire knowledge base for the answer. Basically, it's probably more intelligent than other smart assistants.

So what does the Google Assistant know about you? Pretty much everything tied to your Google account, like mail, contacts, storage, or calendar info. If you're logged into Google and search for something, then Google has that search saved and tied to your account. With the Google Home, Google says it collects your data (questions, buying preferences, location) in order to make their services faster and smarter. The goal is that over time, Google Home or your Pixel phone will be able to provide better and more personalized suggestions and answers.

Targeted, relevant ads are Google's famous example of how this data aggregation can help you. Most people are okay with that, but if you're worried about privacy, you

can delete your conversation or search history at any time. Google also promises that your data is secure, "protected by one of the world's most advanced security infrastructures. Conversations in Google Home are encrypted by default."

**Technologies and type of input**

Google Assistant can be installed on most smartphones with Android System, on the Speaker, Watch (Android OS), Laptop (Android OS), TV (Android OS), Car (Android Car OS), Smart Display (Android OS).

**Functions**
Education/Catalogue/Entertainment/Planning

**Humanoid interface and its properties**
For google assistant you can choose a voice: male or female (for some languages). The interface represents four dots of Google brand colors (soft blue, red, yellow and green) moving in animation for mobile devices and static lights for the speaker. There is no human-looking interface.

**Interaction**
Methods of interaction: voice, omni channel interaction (working with platform and app environment)
Data input: voice, text
Data output: voice, text, images, links, maps.

**Speech properties**
For google assistant you can choose a voice: male or female (for some languages). The interface represents four dots of Google brand colors (soft blue, red, yellow and green) moving in animation for mobile devices and static lights for the speaker. There is no human-looking interface.

**Dialogue structure**
The assistant has two models of dialogue:
-Answer (user)-question (assistant)
-tips and advices in case of mobile app usage

**Customization**

Possibility to customize the voice, 8 types
Customization of the google search bar on Android OS devices

**Seamless**
Possibility to integrate Actions - sort of applications created by third parties that can
be integrated in the Google assistant. Anyone can develop their own Actions for the
Assistant and thus expand its functionality, making it even more useful for users.
No human help is not provided.

**Most common actions**
By December 2017 (according to voicebot.ai statistics) [voicebot.ai, 2017] the major
part of requests were connected with games and fun (27,4%), Education and
reference (9,3%) and home control (9,2%).
It should also be noted that only 3,7% of requests were related to Shopping.

**Integration with other platforms**
Google Assistant is deeply integrated with its parent platform (Android OS) and
provides seamless experience with most of its services (calls, messages, emails
etc). Besides, Google Assistant can work with many of the most popular applications
and third party services (Spotify, Philips Hue etc).

**Welcome screen**
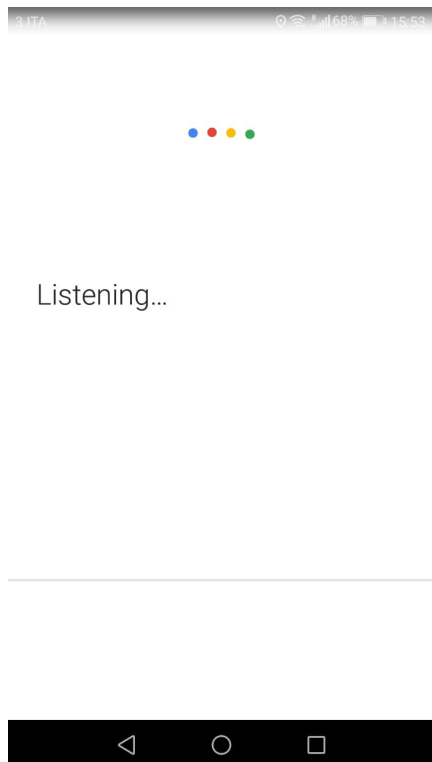
**Examples of actions:**

- Calender and Agenda

  What's next on my calendar?

  I found this in your Google Calendar for today

  | Oct 21 | Coffee with Samantha |
  |---------|----------------------|
  | 11:30 AM | Cody's Coffeehouse |

  When's my flight to Barcelona?

  Here are the flights that I found in your Gmail

  Oakland to Barcelona
  Wed, Nov 15 • 8:45 PM

  OAK ✈ ————————————• BCN

- Home control

  Turn the temperature to 72 degrees**

  Ok, raising temperature to 72 degrees

  Dim the living room lights**

  Sure, dimming the lights

- Music and entertainment

  Play study music on Spotify

  Sure. Here's a Spotify playlist called Intense Studying: Piano Concertos Edition

  Pause

  Alright

- Calender and timing

What time is it in Tokyo right now?

Here you go

7:49 AM
Wed, Nov 1, GMT +9:00
Time in Tokyo, Japan

# Virtual Customer Assistant or VCA

**Virtual Customer assistants** is a conversational platforms based on the technologies of artificial intelligence that is a part of a sales system, whose goal is to interact directly with the customer to provide assistance and support for the product (products) or service (services), leading the customer flow, and improvement and enrichment the shopping experience.

**How people are using virtual customer assistants.**
Most of the studied VCA have been done for Banking, Telecom of Retail industries.

VCAs are now deployed on multiple channels such as websites, contact center interactive voice response (IVR) systems, mobile apps, consumer messaging apps, social networks, communities, kiosks and Internet of Things (IoT) devices. [Gartner, 2017]

VCAs are not expected to fully resolve customer issues. More often, they're expected to assist customers by giving them a push in the right direction.
VCAs can be used in a variety of technologies, from electronic informational kiosks to business phone systems where they build upon older IVR technologies. But for now, they're most frequently encountered online. Online deployments have lower costs and lower technical barriers, so are often the first step for SMBs and enterprises alike.[Craig Borowski, 2016]

Unlike VPAs, VCAs may not need to be permanently connected to the Internet and use only the internal resources: databases situated on local drive or cloud.

For analysis we have chosen Nuance Nina, [24]7 AIVA, eGain and MyiAgent.

# Nuance Nina

## Nina

**Bring intelligence to life**

**Languages:** Nina supports 39 languages including English, French, Italian, German, Spanish, Mandarin, Cantonese, Portuguese, Japanese, Korean, Arabic and more.

NUANCE

**Available platforms:** Alexa, Facebook, Facebook Messenger, Google Home, Twitter, Twitter Direct Messages, WeChat and other third-party systems such as Salesforce and Google Analytics; SMS.

**Methods of interaction:** Typing, Speech.

**Estimated number of current users:** more than 22 million registered users of Nuance desktop solutions

**August 2012**

**Short review**

Nuance Nina is a Virtual Customer Assistant providing both as SaaS platform and as On-Premises software. It is an Intelligent automated virtual assistant technology for customer self-service

Nina is able to deliver the right experience to the right customer across different channels based on customer intent, online behavior, past interactions and third-party data. Nina supports complex dialogs that allow it to understand the context of the conversation. A highly accurate NLU allows users to chat with Nina in a natural and humanlike way. Nina can ask a human coach for help that either selects the correct intent from the ones presented or escalates to a live agent. This information is then automatically logged, creating a **continuous learning loop** between the VCA and human-assisted conversations — for constant improvement.

**Technologies and type of input**

The Nuance Natural Language Understanding (NLU) technology allows to offer a consistent experience across digital channels: web or mobile browsers, inside an app, via SMS,

messaging apps like Facebook Messenger, or home speakers like the Amazon Echo. This ensures the quality of service your customers expect.

Nina is designed once and can then be deployed in any digital channel immediately or later on. That avoids the typical siloed application development that is usually seen on the market. In addition, Nina Coach seamlessly integrates into human-assisted engagements by either consolidating with a hidden coach or transferring all important data when switching to live chat, ensuring that the user experience is never interrupted.

## Functions
Instructions/Control/Planning

## Humanoid interface and its properties
Nuance Nina is positioned as humanoid interface in form of chat. Despite the fact that Nina is a feminine name, the chat looks like the standard pop-up window  (via a text box) for websites and can not imply any gender of the virtual assistant. In the presentations of company in the chat in the web version Nina has a 3D human image. She looks like a young smiling woman wore in a classic office dress.

## Interaction
Methods of interaction:

Data input: Speech throw Alexa-powered devices or text input on the web version

Data output: Speech or text messages

## Speech properties
The communication is carried out through speech and text. Nina recognizes the intent of your customer's inquiry with high accuracy, personalizes responses based on context, and troubleshoots using conversational strategies like answering social questions, reacting appropriately during customer frustration and escalating to a live chat agent, if needed.

## Dialogue structure
Answer (user)-question (assistant)

## Customization
Virtual Assistant & live chat integrate into a window. This can be personalized to the brand, with the ability to customize the positioning or branding and provide A/B testing without any changes required.

**Seamless**

Nina seamlessly integrates into human-assisted engagements by transferring all important data when switching to live chat, ensuring that the user experience is never interrupted. By referencing 3rd party data, Nina is able to inform context, based on account and product information, and complete transactions.

The platform balances the benefits of machine learning with human knowledge and skill, allowing trained agents to engage and curate how Nina responds when presented with the occasional unfamiliar request. This approach ensures a fast, yet graceful, response to changing market conditions.

**Most common actions**

Ideally, in Nuance's virtual assistant Nina a customer's first request is intercepted by the AI. For example, a banking customer service system integrated with the virtual assistant uses the AI to answer some of the basic transactional queries such as opening an account or figuring out the best account type for a customer. For more complex queries, Nina redirects the customer to a helpline number or the appropriate landing page. That provides seamless customer experience to the consumer. Depending on the platform and background Nina is able to answer some hundreds of customer questions and requests.

**Integration with other platforms**

Nina offers the customers a consistent experience across web and mobile channels. A familiar voice will answer the request whether it's typed into a computer, tapped on a screen or spoken into a device.

Integration with Alexa-powered devices what allows to connect with the popular internet-of-things (IoT) devices.

**Welcome screen**
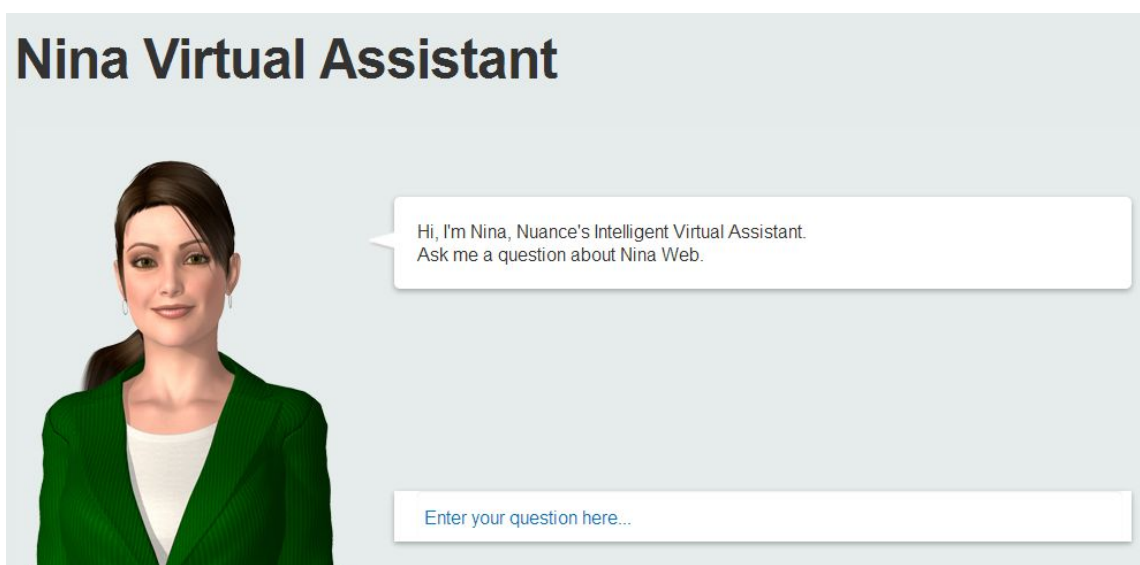
# AIVA, AI Virtual Agent

**Boost Satisfaction by Helping Customers Help Themselves**

**[24]7.ai**

**Languages:** Chinese (simplified and traditional), Dutch, English, French, German, Italian, Japanese, Korean, Portuguese (Brazilian and European), Russian and Spanish

**Available platforms:** Supports phone calls or digital web-integration in form of chat.

**Methods of interaction:** Typing, Speech.

**Estimated number of current users:** n/a

**August 2012**

## Short review

[24]7 AIVA is an AI-powered, intelligent virtual agent (VA) that enables a smarter, more accurate, 'near-human' experience on your voice and digital self-serve channels. Operating on a unified platform, [24]7 AIVA thinks, talks, and takes logical action on voice or digital channels just like your best human agent. [24]7 AIVA can help companies expedite their customer service performance while maintaining a high level of customer satisfaction. AIVA can communicate in natural language, understand context, sense emotions, make logical deductions, solve problems, learn through experience, and support your unifed channel strategy to provide an effortless CX in any channel of your customer's choice. With [24]7 AIVA you can now automate both simple journeys and complex interactions smarter, faster, and more securely.

## Technologies and type of input

Customers can talk to [24]7 AIVA on a company's toll-free number (within the IVR set up) using speech recognition or via both the desktop and mobile version of a brand's website. They can also leverage mobile connect to enable [24]7 AIVA directly inside mobile application and can even activate AIVA on the brand's social

media pages (like Facebook Messenger) using conversation windows. With a common business logic powering all these channels customers get a consistent brand experience on whichever channel they choose. [24]7 AIVA enables a smooth handoff of context and history so the customer can transition between channels without losing continuity.

[24]7 AIVA uses Microsoft's DNN-based speech recognition technology to enhance speech recognition accuracy for your Interactive Voice Response (IVR) systems. Using analysis from Bing search, Xbox, Cortana, and Windows Phone as well as other customer engagement channels, DNN draws on over 10 billion utterances for deeper insight.

**An example of an integrated chat**
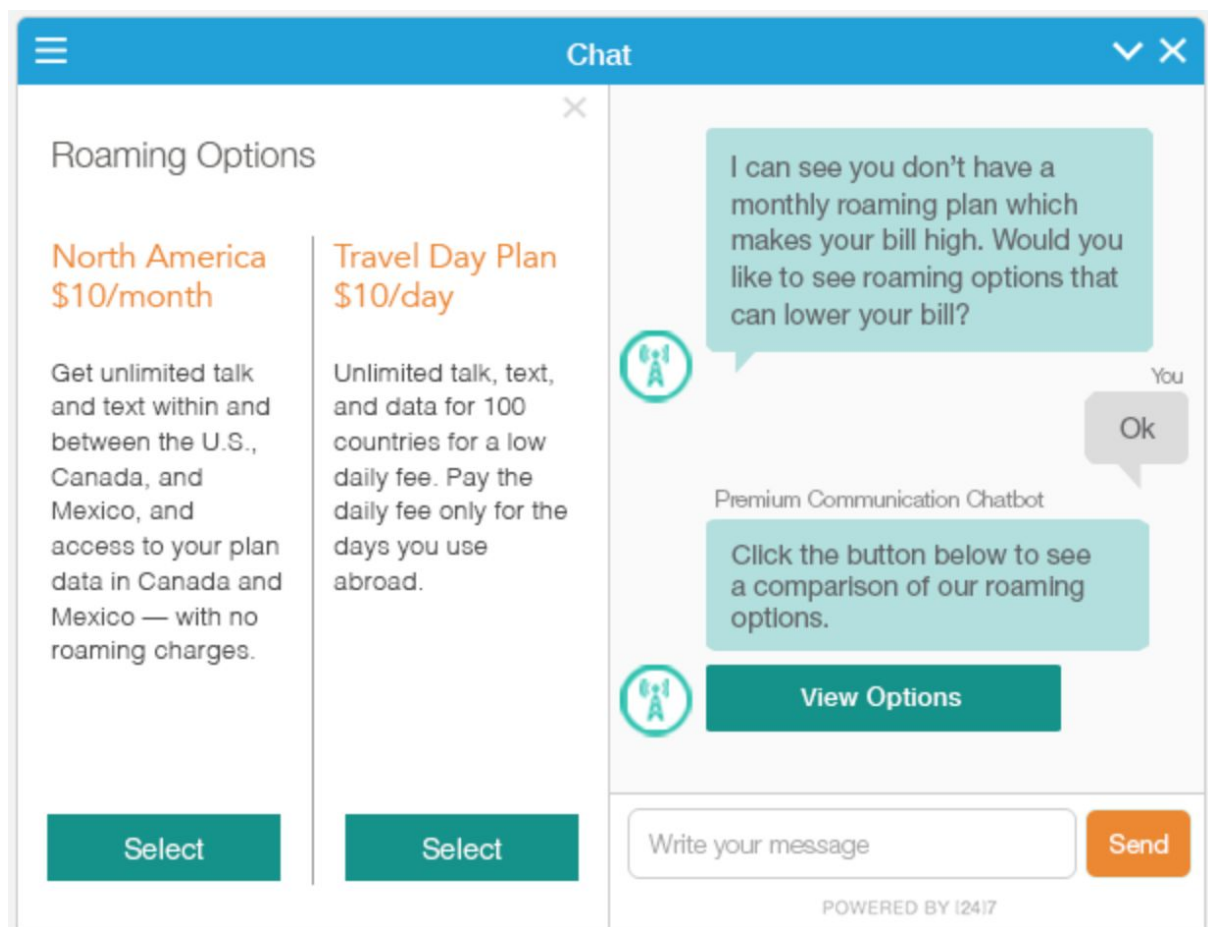


**Functions**
Support/Instructions/Planning

**Humanoid interface and its properties**
AIVA, AI Virtual Agent, is being positioned as a support instrument being able to have 'near-human' conversations. The bot itself does not imply humanoid interface.

However, it can be applied after brand customisation as an avatar in the chat or a concept of a virtual brand assistant.

**Interaction**
Methods of interaction:
Data input: Speech or text input
Data output: Speech or text messages

**Speech properties**
[24]7 AIVA reduce customer service costs without compromising CX and allows to communicate easy with customers. It combines the world's most advanced natural language processing (NLP) technology with an intent-driven engagement platform to enable **'near-human'** conversations in the selfserve channels. It gives customers the support they need from their very first contact with brand—whether they're searching for information or they need assistance with transactions, [24]7 AIVA can guide them at every step with a natural conversation in their chosen language. [24]7 AIVA can understand slang, local nuances, and colloquial speech and can even be trained to emulate different tones based on company requirements. Forcing the customers down a pre-defined selection path or providing only canned responses can limit self-serve performance. With [24]7 AIVA you brand open up customer's engagement to a whole new world of possibilities. For example, with a telecommunication company rather than just providing information like account balance and data usage AIVA can assist with basic troubleshooting and even help complete plan changes or upgrades.
[24]7 AIVA is able to handle two topics and respond appropriately to each by using conversational history and context and asking the right questions.

**Dialogue structure**
Answer (user)-question (assistant), reminders

**Customization**
Virtual Assistant & live chat integrate into a window. This can be personalized to the brand, with the ability to customize the positioning or branding without any changes required.

**Seamless**
Understand what they mean, not just what they say: adding smooth and responsive conversational flow to self-serve interactions speeds up resolution and boosts satisfaction. The customers can speak with [24]7 AIVA just as they would speak with a live agent, because [24]7 AIVA can understand more than just the spoken word—it can intuit meaning in the specific context of the conversation and can be trained to emulate the brand's tone to further strengthen the brand and improve CX.

When negative emotions cross a certain threshold (set by the company) or if [24]7 AIVA is unable to assist a customer further, it can escalate the interaction seamlessly to a live agent for better handling. [24]7 AIVA can also route customers directly to a live agent based on past preferences. [24]7 AIVA connects with the live agent in the same browser window providing conversational history and intent for a smooth hand-off.

**Most common actions**

Solve problems faster with a two-way conversation. To address the complexity of human interactions [24]7 AIVA can engage in a two-way dialogue exchange—what's known in AI as "disambiguation." [24]7 AIVA can even handle multiple intents that are stated simultaneously. For example, a customer in Los Angeles may ask [24]7 AIVA, "What's the weather in New York and book me a flight to Boston for April ffth." AIVA can understand the two intents within this request and identify the missing information

required to complete the tasks.

So [24]7 AIVA understands:

1. The customer wants to know the weather in New York.

2. The customer wants to book a flight to Boston for April fifth.

3. Based on user-profile or other back-end data, AIVA knows the customer lives in Los Angeles so assumes they want to fly out of LAX.

4. The customer has not provided a return date—AIVA identifies this missing information and knows to request it.

**Example of an action**
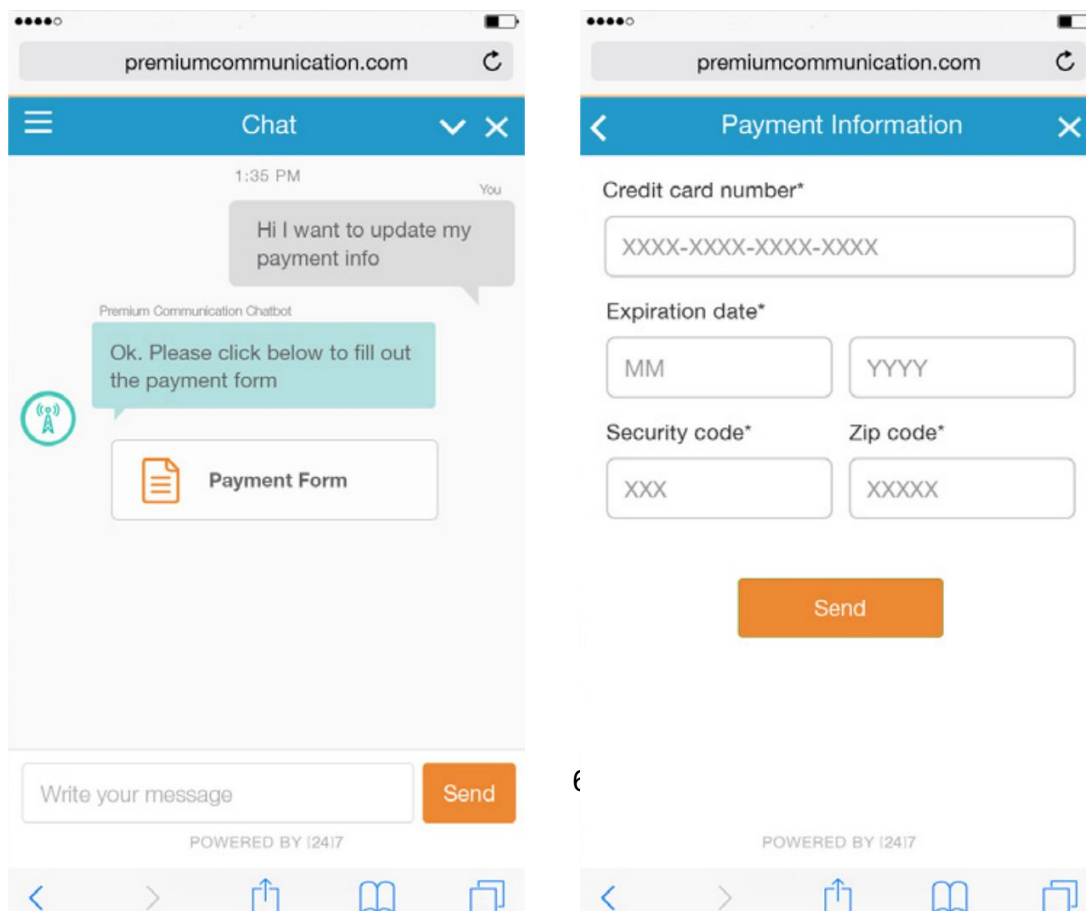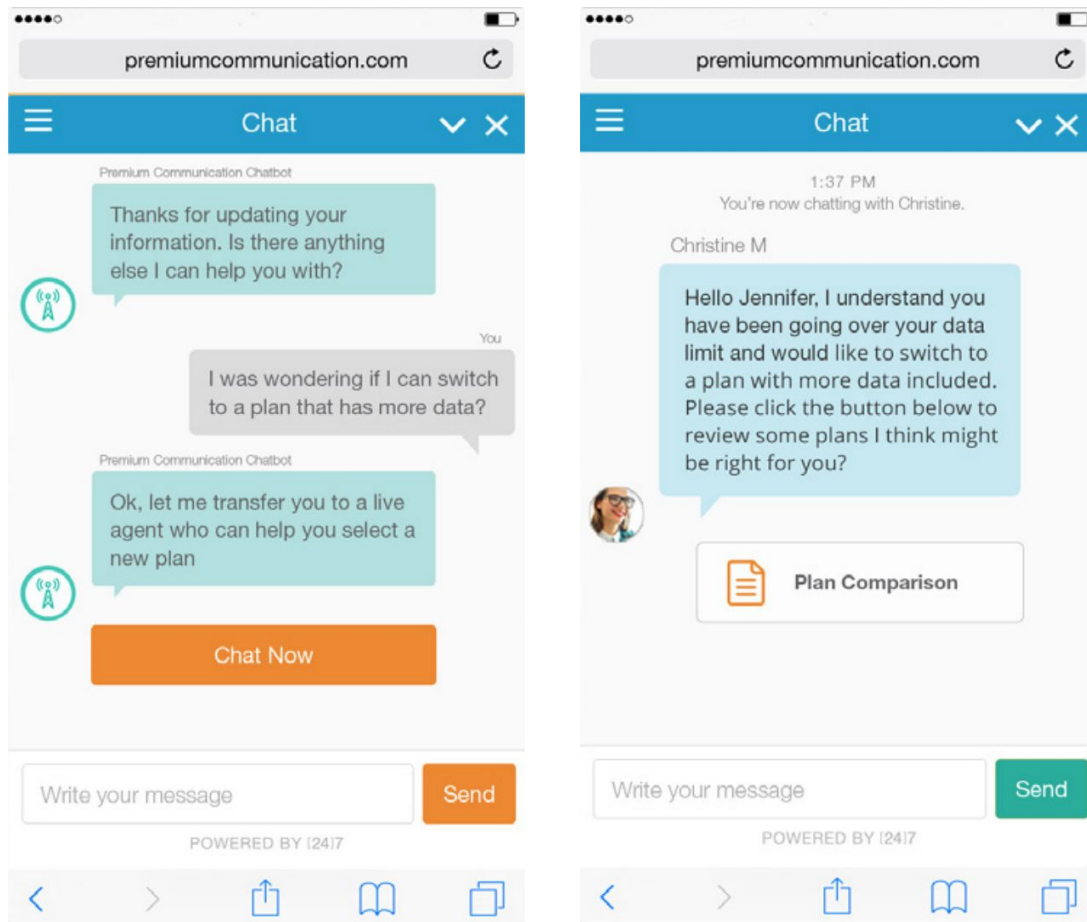
In this example, the customer engages with [24]7 AIVA to complete a payment update. The customer can easily complete this journey using an Active Card.

When the customer requests information about switching data plans, a journey indicated by business rules to be handled by a live agent, [24]7 AIVA **seamlessly** transfers the customer to a live chat. The agent receives the customer context from [24]7 AIVA right in the agent console, so the customer never has to repeat their information or what they are trying to do.
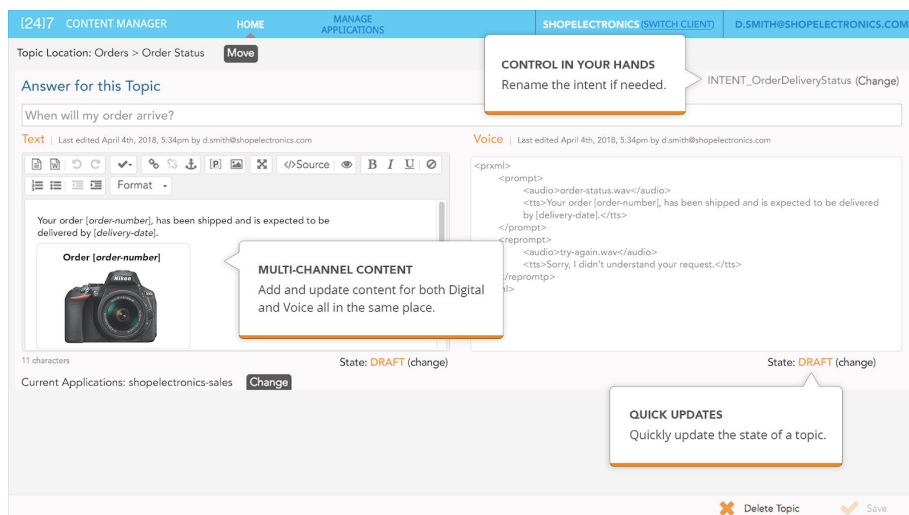
# eGain Virtual Assistant (eVA)

**!** **n/a**

**Languages:** English (U.S. and U.K.), Italian, Japanese, Portuguese and Spanish

**Available platforms**: Microsoft Dynamics 365, Salesforce and SharePoint

**Methods of interaction:** Typing, Speech.

**Estimated number of current users:** n/a

**start** **2010**

## Short review
eGain Virtual Assistant is brand-aligned *avatar-based* chatbot.
eGain Virtual Assistant is a life-like, conversational agent providing an interactive and personal way for users to get answers and assistance on your website, 24 hours a day, 7 days a week. A customer simply chats with the assistant, and the assistant acts as an agent, providing answers, processing data, and solving customer problems. eGain Virtual Assistant provides frontline support so the customer service staff can concentrate on more complex tasks.

## Technologies and type of input
eGain Virtual Assistant includes out-of-the-box avatars, multilingual support, knowledge base (KB), and analytics for continuous improvement. Besides answering questions, the chatbot can push relevant web pages and take customers on website tours. It supports text-to-text, text-to-speech, speech-to-text, and speech-to-speech communications. Businesses can also expand its reach by embedding it in apps and social networks. The channels of interaction are social, mobile, web, and contact center use.

## Functions
Support/Instructions/Catalogue

## Humanoid interface and its properties

By default eGain offers to its customer 6 types of characters. One of them is a smiley robot, another one is a cartoon cellphone. Four of them have human appearance, but only one looks like real person, when other three are painted characters.



*Robin*



*Maya*



*Davis*



*Zoe*



*Phone*



*eVA*

## Interaction

The virtual assistant supports text-to-text, text-to-speech, speech-to-text, and speech-to-speech communications
Methods of interaction:
Data input: Speech or text input
Data output: Speech or text messages

**Speech properties**
When eGain's NLP AI technology is combined with another powerful eGain AI technology—the Case-Based Reasoning or Guided Help capability—the virtual assistant or chatbot becomes even more effective as a customer service tool.
The natural language processing technology embedded in the chat-bot enables it to not only understand the words, but also the customer intent. The VA acts like a guide taking customers on a tour of the website, providing answers, and even helping in their shopping decisions.

**Dialogue structure**
Answer (user)-question (assistant)

**Customization**
To reinforce and leverage the brand, the assistant can be modified in appearance, tone, and personality to best reflect the company's message and style. The eGain Virtual Assistant projects a consistent image for the company and can aid in integrating
The interface of the assistant can be changed by applying new graphic and structural parts, also by creating a new appearance for the personage.

**Seamless**
The eGain VA is smart enough to know when to escalate to a human agent. By providing timely and context-aware escalation to agents, it stops the customers from having to repeat their query, greatly reducing customer frustration and agent anxiety.

The eGain VA is powered by AI and leverages a knowledge base, including NLU and guided reasoning. It is uni ed with human-assisted touch points such as chat and co-browse for seamless customer journeys, and can be deployed on website, mobile, social channels and others.

**Most common actions**
The eGain Virtual Assistant can be up and running on a website within a matter of days, helping the customers and reducing the burden on real agents. The assistant already knows how to complete common business tasks, and upon installation will:

- Greet users on your site
- Answer FAQ
- Take users on a tour of web site
- Conduct surveys
- Escalate issues to a live agent when the assistant doesn't know the answer

For customers who are already leveraging the power of eGain's other interaction channels, eGain Virtual Assistant provides intelligent escalations for a more streamlined and comprehensive service solution.

**Integration with other platforms**

Businesses can expand the existing methods of interaction by embedding it in apps and social networks.

The eGain virtual assistant is a part of the cluster of cloud applications for social, mobile, web, and contact centers help clients deliver connected customer journeys in an omnichannel world.

It can be integrated to a website of application, it also supports integration of the service with Facebook page using Facebook Messenger .

**Welcome screen**
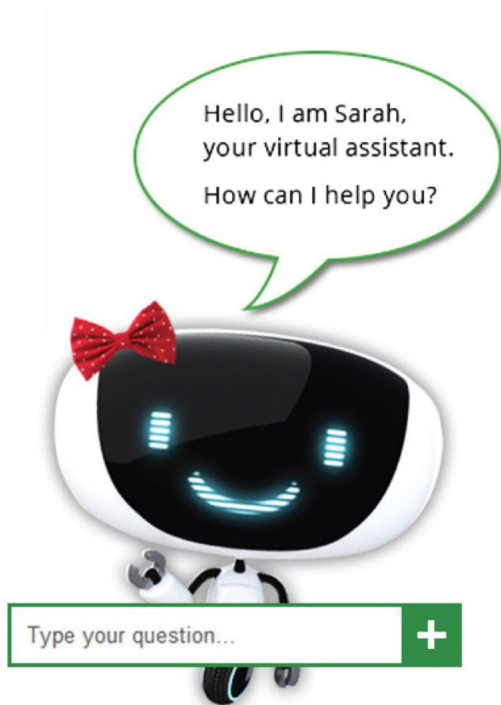


Welcome screen with eVA          A customization: Chatbot RED for Vodafone

# MyiAgent Virtual Agent Software

**n/a**

Languages:English

**Available platforms:** Email, IFTTT, Slack, SMS, Todoist and Wunderlist

**Methods of interaction:** GUI, Speech.

**Estimated number of current users:** n/a

**2015**

**Short review**
MyiAgent VCA technology incorporates an easy-to-use code-free Authoring Console that enables the rapid development of interactive conversational work.

MyiAgent Virtual Agent Software enables businesses to consistently deliver professional receptionist experience at all office locations 24/7. You can use MyiAgent for reception, receiving, greeting, scheduling, controlled access, and many other reception duties.
A receptionist is often the first business contact a person will meet at any organization. The receptionist should be calm, courteous and professional at all times.  Visitors and customers expect an attentive well-groomed receptionist with a positive attitude and a high level of engagement. Business owners require dependability, loyalty to the company, safety and security-mindedness and professionalism at all times – including high-demand and high stress periods.

MyiAgent Virtual Agent Software can be used to supplement the existing staff, or as a cost-effective means of staffing a location without the expense of a dedicated paid employee.

**Technologies and type of input**
The i-Command technology platform allows for human engagement by using voice recognition software for translating speech into an intuitively natural conversation between information and action. The customizable platform can scale across

multiple areas of any organization to increase process efficiencies and overall customer experience and satisfaction ratings.

MyiAgent Software provides with the ability to track and measure the conversations, requests, and results at your reception desk via the cloud management console – from anywhere, 24/7. Both Virtual Receptionist and Virtual Training Agent solutions provide with a back end authoring console which can be updated and modified in real time. i-Command technology allows to modify user options, streamline conversations, narrow down choices, add or edit employees and resources such as meeting and conference rooms, counseling centers, exam rooms as needed. The solution is able to use Microsoft Kinect to understand user's intentions.

**Kinect is used to catch the info coming from customer**



**Functions**
Support/Instructions/Planning

**Humanoid interface and its properties**
The i-Command offers to its customer a virtual reception agent that has human appearance. User can choose one of 4 different characters and set it up for their needs. There are 3 female and one male characters, each of them has its own presets and characteristics.

**Interaction**
Methods of interaction:

Data input: Speech and GUI
Data output: Speech

**Selection of a character**



**Reception Service Agents**

| Accounting Practice | Legal Office | Medical Practice | Manufacturer |

Greet the visitor, Determine reason for visit, Contact relevant staff member, Organise drop off or pickup documents, Security Sign-in, Explain information about your company, Organise Tea/Coffee for wait period

Greet the visitor, Determine reason for visit, Contact relevant staff member, Organise drop off or pickup documents, Security sign-in, Explain information about your company

Greet the visitor, Determine reason for visit, Determine urgency of consult, Validate Medicare details, Confirm appointment details, Contact relevant nurse or doctor, Confirm appointment

Greet the visitor, Determine reason for visit, Contact relevant staff member, Organise drop off or pickup documents, Security sign-in, Explain information about your company, Organise product service

**Speech properties**
Virtual Receptionist software solutions are presented via PC and Kiosk. i-Command solutions include natural voice recognition for a fully 2-way conversation. This offers both convenience and efficiency to the office and professional environment.  With i-Command MyiAgent software solutions it is possible to create Virtual Receptionist that is tailored to specific business needs.

**Dialogue structure**
Answer-question (from both sides)

**Customization**
The solution allows to its user to select an appearance from several variants. The conversation flow can be also customized and has graphical interface in form of branched structure on the admin panel.

**Seamless**
i-Command's Virtual Receptionist Software gives insight into every conversation. Every exchange with the customers and clients is logged and tracked. Any new or different requests that fall outside of your workflow are noted as anomalies. These are gathered and sent to designated SME (Subject Matter Expert) for review and implementation into a standard process.

**Most common actions**

Greeting and Welcoming your front desk visitors is an essential first impression for business. Properly routing and handling the diverse requests of the clients, customers, visitors and vendors can be a daunting task for reception staff. The aim of Virtual Receptionist Software from i-Command is to effectively handle the increase without over burdening existing employees.

MyReceptionAgent Virtual Receptionist includes a fully accessible back end authoring console which allows you to build a workflow for every possible need. There company proclaims there are no limits to the capabilities of the Virtual Receptionist Software. Everything from scheduling an appointment, registering for an event, inquiring for more information on the product or service, joining mailing list, requesting additional information, checking in for a scheduled meeting or interview, taking a survey, to providing feedback about company is available and at the control with the i-Command MyReceptionAgent solution.

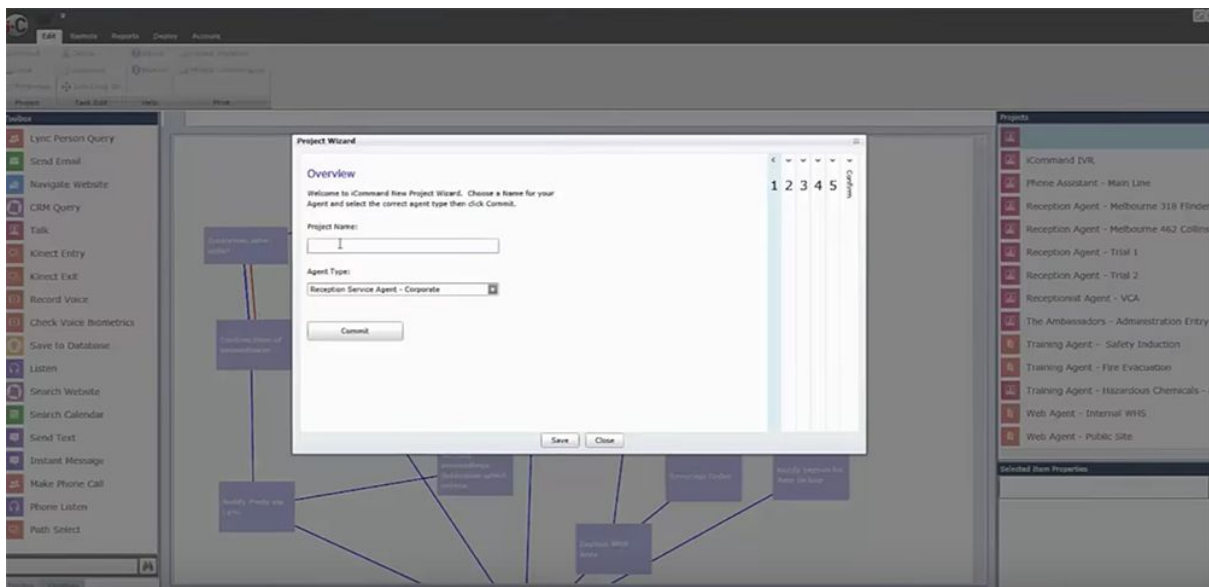**Example of an action in backoffice**

*Table 3, Strengths and weaknesses of 5 Virtual Assistants.*

| | Advantages | Disadvantages |
|---|---|---|
| **Google Assistant** | Memory: uses previous phrases to enrich user experience | Can't read or send emails or message, asks permission for every new action with customers data |
| | Multiple Actions: can get multiple things at the same time | Needs a special device to communicate |
| | Voice identification: can identify different voices | |
| | Big database: has probably the biggest knowledge base thanks to Google Knowledge Graph | |
| | Good quality natural language recognition: can understand many types of phrases | |
| | Seamless experience between devices under one account | |
| | Voice customization: it is possible to choose out if six available voices | |
| | In near future it is going to be able to call to book | |
| | The personal data is protected | |
| | | |
| **Nuance Nina** | Can use many platforms: facebook, sms, calls | Needs to be trained and set |
| | Customization: Brand-aligned avatar-based chatbot | Needs to be installed |
| | Seamless, context-full escalation to assisted channels, to agent-assisted chat when necessary. | |
| | | |
| **[24]7 AIVA** | Can perform transactions | Needs to be trained and set |
| | Can use many platforms: facebook, websites, social media channels, email, calls | Needs to be installed |
| | The base of the answers is constantly expanding and can be expanded by customer | |
| | The chats are encrypted | |
| | The assistant is context-aware | |
| **eGain** | Customization: Brand-aligned avatar-based chatbot | Needs to be trained and set |

| | | |
|---|---|---|
| | Seamless, context-full escalation to assisted channels, to agent-assisted chat when necessary. | Needs to be installed |
| | Available as saas of software for OS's | |
| | | |
| **MyiAgent** | Humanoid interface | Human appearance does not look much realistic |
| | Creation of scenarios: for scheduling appointments, registering for events, inquiring for information, joining mailing lists etc | Needs to be installed |
| | Can log and track every exchange with the client | Needs specific devices to communicate better (Kinect) for better user experience |
| | | |

As a result of the comparative analysis, the strengths and weaknesses of virtual assistants were revealed.

**Google assistant** has great advantages over other assistants in terms of recognizing the context. Having a huge knowledge base, Google assistant is able to understand any query. In addition, it is able to understand the context of a phrase, divide it into queries, and prioritize them. Google assistant is able to recognize the voices of users and systematize information for each user individually. Soon, he will also be able to form a separate dialogue with a third person on request, for example, to order a table in a restaurant.

Being a platform, Google Assistant should ask permission for many actions to do. Google assistant is personal assistant so it can not be used as an implemented virtual assistant for retail.

**Nuance Nina** is one of the most successful solutions on the field of the virtual customer assistants. Nina supports a variety of platforms, including built-in web chat facebook, sms, calls and even Amazon Alexa.
The assistant provides seamless customer experience thanks to multiple connected channels of communication and human-assistant chat in case when it is necessary.

Before being deployed Nina should be set and trained for every client. The preparation and deploy can take some time.

**[24]7 AIVA** is virtual customer assistant providing 'near-human' experience on voice and digital self-serve channels (both voice and digital). AIVA provides better security encryption all the client chats.

One of the most important differences is that AIVA is able to perform transactions according with the customer demand.

The assistant uses with many platforms as facebook, social media channels, email, sms etc. The database of questions and answers is growing with the use of the program, so more clients it has better quality information it provides. Thanks to this fact AIVA is context-aware. It means that the assistant is able to use the context of the conversation to better understand the requests of user.

The assistant should be set before usage.

**eGain** virtual assistant is a lifelike, conversational virtual agent providing a unique, interactive, and personal way for users to get answers and assistance on the website. eGain provides seamless experience thanks to the possibility to switch from virtual assistant channel to real agent whenever it is necessary.

eGain has only the form of chat. The assistant should be deployed or installed and set before using.

**MyiAgent** is Virtual receptionist software solution. This assistant has human appearance and is able to answer the phones, routing calls, fill and administrate, track down employees, and manage multiple calendars and meeting venue. MuiAgent logs and tracks every possible exchange with the client.

The appearance of the assistant is based on 3D model and is displayed on the screen. Sometimes it can look unrealistic. A special device like Kinect is needed for the better communication.

## Conclusions

The analysis of case studies showed that most virtual assistants work in a similar way. Channels of interaction, technology, customer experience are the same for all of them. At the same time, each of the assistants is unique in its set of functions, a niche in the market and way of promotion.

The VCA implementations seek to intervene in activities in which customers are already engaging. In other words, the VCA isn't an additional or independent support channel, rather the VCA is added to support existing channels or existing customer behaviors.

Most of the assistants have been developing for several years and have made some progress in the natural speech understanding of the users and generating answers. However, all of them are still far from the present conversation with the consumer. Their communication, no matter how advanced technologies are beyond, is still being built on the "question-answer" scheme. Only some of the virtual assistants can use the data from the previous question to build the answer to the next one. But none of the analyzed assistants can yet determine the context independently (meaning not the topic, namely the context: style, mood, intentions of the user).

The interface of virtual assistants is graphically represented in the form of a chat (without human appearance), a chat with an avatar (character or photo of a person) or as an interactive 3D model of the assistant-person.

# 3.
# ELSE Corp

## Overview

ELSE Corp is an Italian B2B2C (Business-to-Business-to-Customer) startup based in Milan founded in 2014. The startup resided in Politecnico di Milano's startup acceleration center Polihub, Milan, Italy and the core of the business is focused on designing and developing an advanced cloud service solution that combines front-end and back-end retail processes to be offered to the retailer brands in apparel and luxury fashion industry.

*Fig. 9, Scheme of ELSE Corp work*
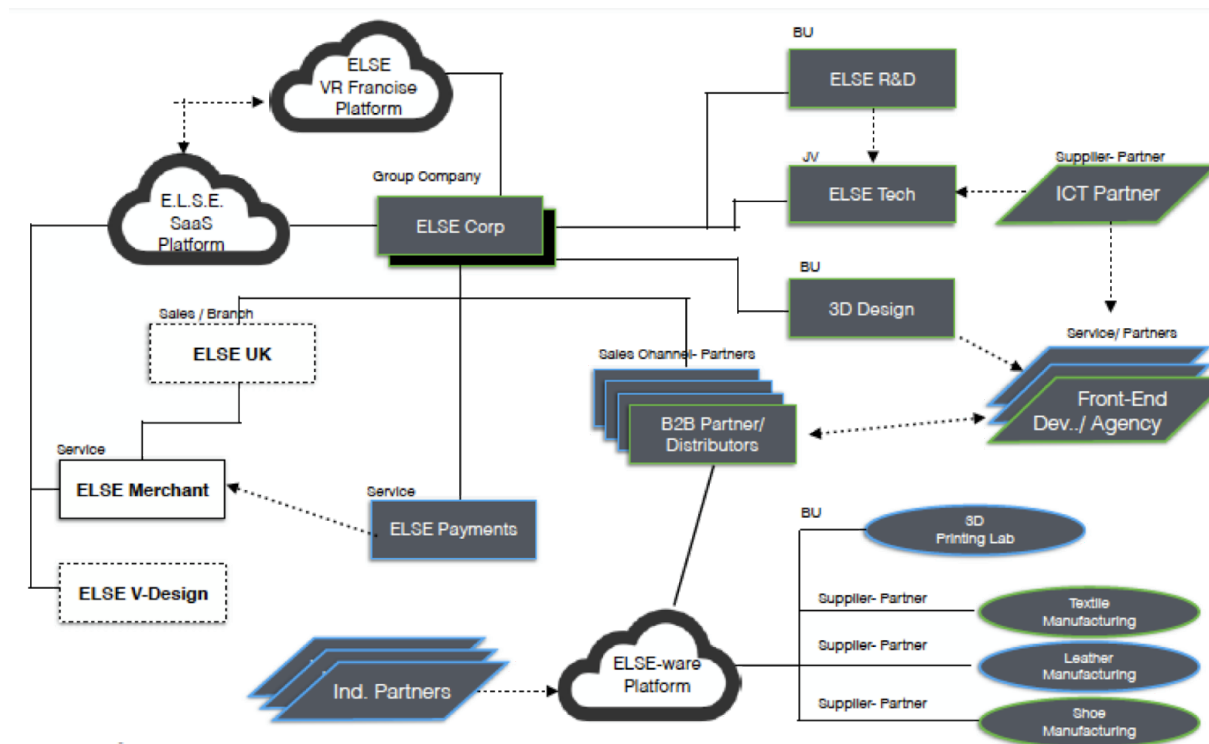


## Virtual Retail and Real Time Fashion System

Virtual Retail is an innovative hi-tech industrial process for 3D CAD & Cloud based Mass Customization of fashion products. It transforms brand distribution channels into new concept spaces within brick and mortar stores (shop in shop, popup & temporary shops) named Virtual Fashion Corners, where a 'new customer experience' of Virtual 3D Shopping, focused on product personalization can be easily realized. It represents a turning point for future methods of retail and manufacturing, providing new innovative strategies for the sales, design, production, distribution and marketing of fashion products.

Virtual Retail, a system developed by the ELSE Corp (Exclusive Luxury Shopping Experience), introduces an innovation in the Fashion Retail sector for the apparel and footwear industry. Through the Virtual Retail platform it is possible to shop in 3D and order customized products.

The system enhances the customer's virtual shopping experience and optimizes the Virtual Retail production chain through the use of AI, machine learning, deep learning & procedural modeling. Driven by the integration of 3D & 2D CAD systems and Artificial Intelligence, which lead to accurate predictions of the style and size needs of individual customers, and guarantees the real-time demand planning and forecasting. It is a vision for a new product design process for companies and independent designers, that leads to the precise prediction of individual needs and product demand while improving the social and environmental impact of the fashion industry, on a global scale.

Virtual retail is playing a vital role in the marketing strategy of brands that wish to keep up with the constantly evolving retail landscape. It allows brands to create virtual replicas of the original products and help customers to visualize and eventually order products without seeing the physical items [Ward, 2016]. These virtual prototypes expose the brands to more opportunities, not only as a way of visualizing a non-existing product, but it also allows for the mass customization of products, the integration of analytics, smart manufacturing, smart supply chain management, and 3D printing. Interacting with virtual products allows customers to gain relevant information about the products, increases the customers' assessment and perception of the quality and performance of the products, and enhances their feeling because of the novelty of the experience [Algharabat R. S., 2014].

With the help of artificial intelligence, Virtual Retail provides the user a new customer experience. Salesperson services here can be replaced with the help of a virtual assistant, making easier the choice for client and repeatedly speeding up the response to their requests.
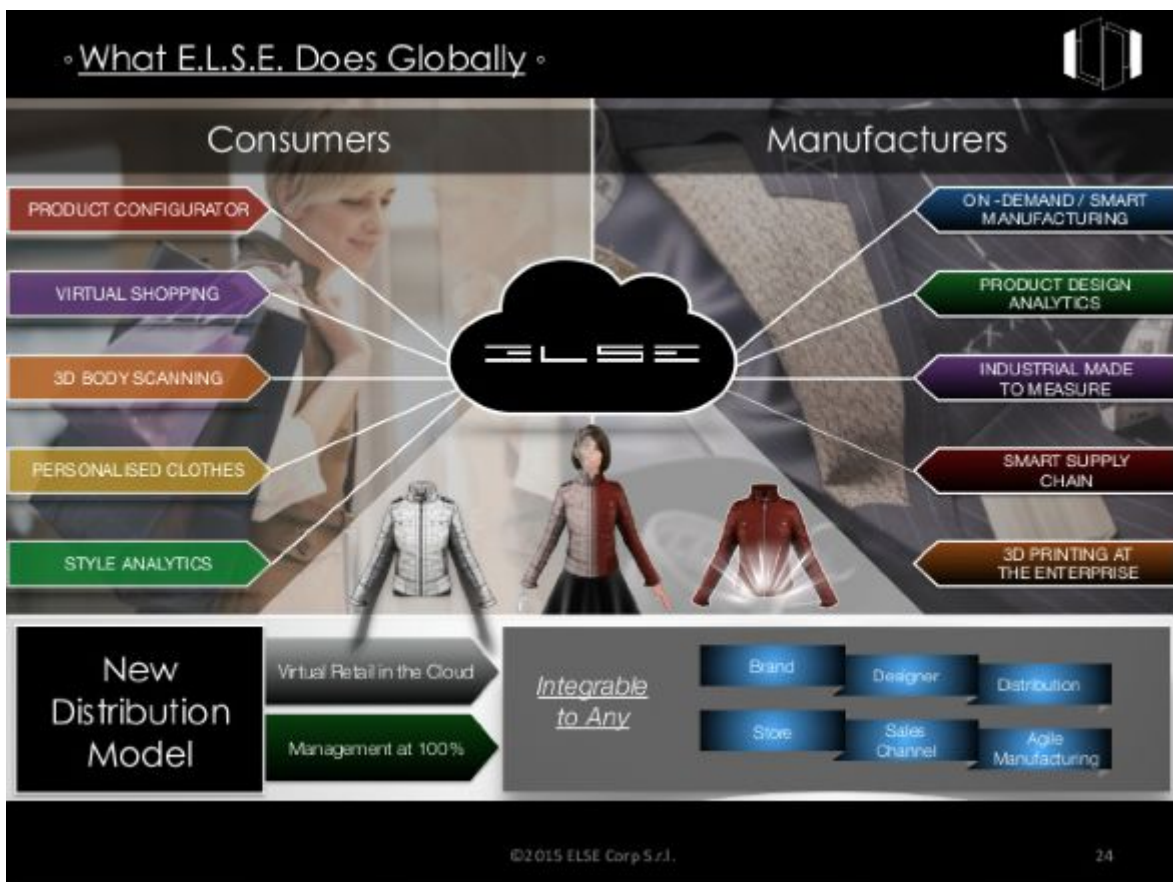
**Mass customization**

The concept of mass customization is part of the core business model of ELSE. Mass customization can be defined as aiming to produce products or services that appeal to individual customer's needs with an efficiency that is close to mass production [Tseng & Jiao, 2007]. While engaging in mass customization, the user is involved into value creation by infusing their personal preferences out of a list of predefined components [Piller, Schubert, Koch, & Moslein, 2004]. Although it is an attractive business proposition, the implementation is however quite complex. In the concept of mass customization, a customer becomes a co-designer. In this process, the customer can make customized combinations of product specifications from a defined selection. To make this process feasible, the customer is to be presented with a design toolkit, commonly called a configurator, to guide the user throughout the customization [Piller, Schubert, Koch, & Moslein, 2004]. ELSE offers an interactive virtual product configurator that makes it easier for customers to visualize their products with an array of physical or virtual samples to choose from.

It's not a secret for anyone that the assortment of luxury brands is not fully sold, while the maximum amount of resources is spent for its creation, both human and

material, many of which are far from ethics. In the case of a project like Else Corp, and its counterparts, the problem can be partially solved.

Such services as Virtual configurator also largely help to solve the problem of pollution and an overabundance of things, which quite corresponds to the ideal model of reasonable consumption and ethical production.

The goal is to optimize every contact a prospect may initiate with the brand and focus on providing an excellent brand experience wherever they meet the brand—not just on a single channel.

**Business MODEL**

One of the main goals of ELSE Corp is to accelerate the transformation of the fashion industry towards a Product as a Service model. These plans to be made possible due to the automation and extending the reach of product customization and industrial approach to Made-to-Measure (MTM) selling to a wider audience.

The startup receives a small percentage of the amount directly sold to the buyer for providing a ready solution to its partners and customers. Plus this technology in many respects is that it helps to reduce the cost of purchasing materials and generally save on infrastructure due to the fact that all creative processes are processed in the cloud and individually for each buyer.

An 'ideal' Virtual Fashion Retail experience on the E.L.S.E. platform is comprised of these six core elements:

- Virtual Boutique 3D app: The first point of contact, it is a digital representation of the brand's retail space, navigable via embedded hotspots. The Virtual Boutique is a customisable UI (via an SDK) of the 3D Configurator.
- Virtual Catalogue 3D app: A navigable catalogue of all shoppable virtual products.
- Cloud based 3D Configurator: It is a real-time 3D rendering front-end application framework based on E.L.S.E. APIs, integrable into a brand or retailer's offer on any platform (web, mobile, AR, MR, VR etc.) via a dedicated platform UI SDK - providing an extraordinary customisation experience.
- Sales assistant tablet app: A remote device to navigate through and select the options of the 3D Configurator.
- 3D foot / body scanner and its tablet app: To gather the customer's measurements.
- Physical Samples and test products: Material and product part samples introduce a tangible side to the customisation process, giving the customer a sense of the texture and quality of the final product.

ELSE is developing some different types of applications for customizing.
-The web-based cloud application is the mane place to test and develop the new functions off the application (or framework) develop. The applications being delivered to the clients are all web-based.
-Unity-based virtual reality product configurator which exploits the technology of Virtual Reality using virtual reality helmet.
-Unity based augmented reality configurator using the powers of Microsoft HoloLens technologies.

**Virtual 3D configurator as a SaaS platform**
The company has been developing a technologically advanced **SaaS** (Software as a Service) platform, focused on providing an extraordinary customer experience, that offers no stock retail.

This cloud platform that ELSE Corp is currently developing can be seamlessly integrated by the retailer brands to sell virtually customizable and industrial made to measure mono and multi products.

The company works on the design and development of a technologically advanced Cloud SaaS & API platform and the related know-how about its key concepts: Virtual Retail and the Real Time Fashion System. In fact, the ambitious goal of ELSE Corp, consists of a Fashion Retail industry revolution based on these two principles, in two different directions, which are an integral part of the strategic vision of the startup, Virtual Retail and Real Time Fashion System.

ELSE-Corp offers a retail platform that is set out to realize the business model that is called "Virtual Retail". This platform proposes an innovative hi-tech industrial process that offers a new way of visualization for e-commerce. It also creates new concept spaces or "virtual corners" for brick and mortar stores. With these virtual corners, customer experience is redefined because a new way of virtual shopping that is based on interactive virtual products is realized. The virtual retail platform that ELSE offers covers the whole process from virtual sales to adaptive manufacturing, and after-sales experience (ELSE Corp, 2017).

On the other hand, the main selling of the startup is to create a concept of 3D product configurators for product customization. ELSE Corp has in fact been developing a product configurator that is to be integrated to the front-end processes of mass customization of exclusive personalized made to measure products. As a startup, the company has been developing a web application version of a shoe (or any different type of product) configurator that is integrated to the cloud-managed back-end processes such as order creation and smart manufacturing.

In the existing services of e-commerce, ICTs support the accessibility of products making them available from everywhere, for everyone, at any time; furthermore, they offer limitless opportunities of information and social exchange about goods. For these reasons, the discussion about digital services for retail is often focused on factors related to process effectiveness and on market opportunities, such as on the use of data and big data to orient production, on new forms of advertising, on production systems allowing product personalization and more. [Pillan, Vitale, 2016]

The core of the business is focused on designing and developing a cloud platform that combines front-end and back-end retail processes to be offered to retailers. This technologically advanced Cloud platform is a **Software-as-a-Service (SaaS)** application program interface (API) that offers no stock retail for industries concerning apparel and footwear. This platform can be seamlessly integrated by brands to sell virtually customizable and industrial made to measure products [ELSE Corp, 2017].

The Cloud  based Universal 3D Product Configurator and MTM sales support system are based on proprietary, multi-patent pending, processes.
Customers can experience this Virtual Shopping CX through different channels – from a completely virtual experience delivered via Augmented, Mixed or Virtual Reality devices; to Virtual Retail Corners in real physical spaces.

The main aim is creating the framework / API that allows to potential future clients to create their own product configurators (Powered by ELSE product configurators)

The E.L.S.E. infrastructure is built on the Microsoft Azure cloud platform and the middleware and front-end solution leverages Azure's various modules and architecture of microcredits for the creation of the "Universal 3D Product Configurator", which integrates visualization and real-time 3D personalization. A front-end module for Augmented Reality is also available on Windows 10 tablets, and the shopping experience has been enabled through the Microsoft HoloLens mixed reality holographic computer, which allows you to interact with holograms projected in the real world and to see the finished product and the performance of models in different contexts, from casual to posh. ELSE Corp is also developing the new features of the E.L.S.E. platform, focusing on Microsoft's machine learning and cognitive services, to intercept market trends and anticipate customer needs in order to better plan production and optimize the entire supply chain. It is an ongoing project that aims to improve real-time forecasting and understanding of the needs of individuals, to optimize the global impact of the fashion industry and to introduce a sustainable perspective for the fashion system.
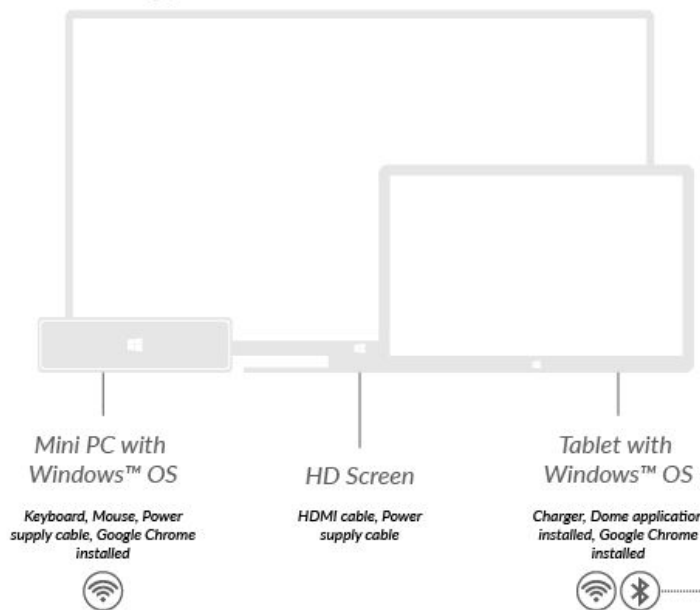
**Structure of web-based Cloud Application**

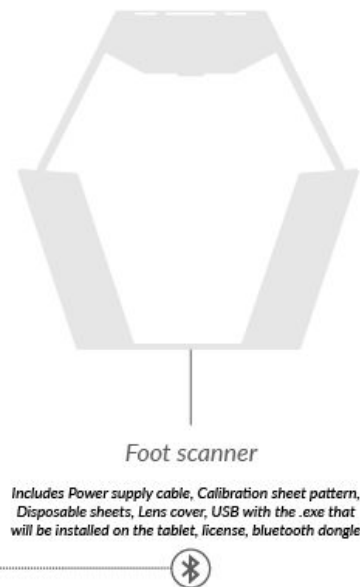Technologically web-based application is created on base of the web technologies:

-HTML+css (less preprocessor) "skeleton" of front end interface

-Java script as backend technology (including the fitting technology) that is the core of the future API/framework "Powered by ELSE"

*Fig. 11, Application set*



The client works only with the HD screen to see the configuration of the product, whereas the salesperson works with the tablet to control the main screen and operate the customer profile if it is needed. Customer also uses the foot scanner to scan their feet.

During the working on the project of the web-based Cloud Application (here and later "Configurator") we created a generic mono-configurator scheme which explains the customization of the product by the user according to the intended scenario: from the opening of application, through the selection of collection and model, logging in, customization of choosing model, previewing, concluding by the order of the item.

Fig. 13, scheme of the web-based virtual configurator
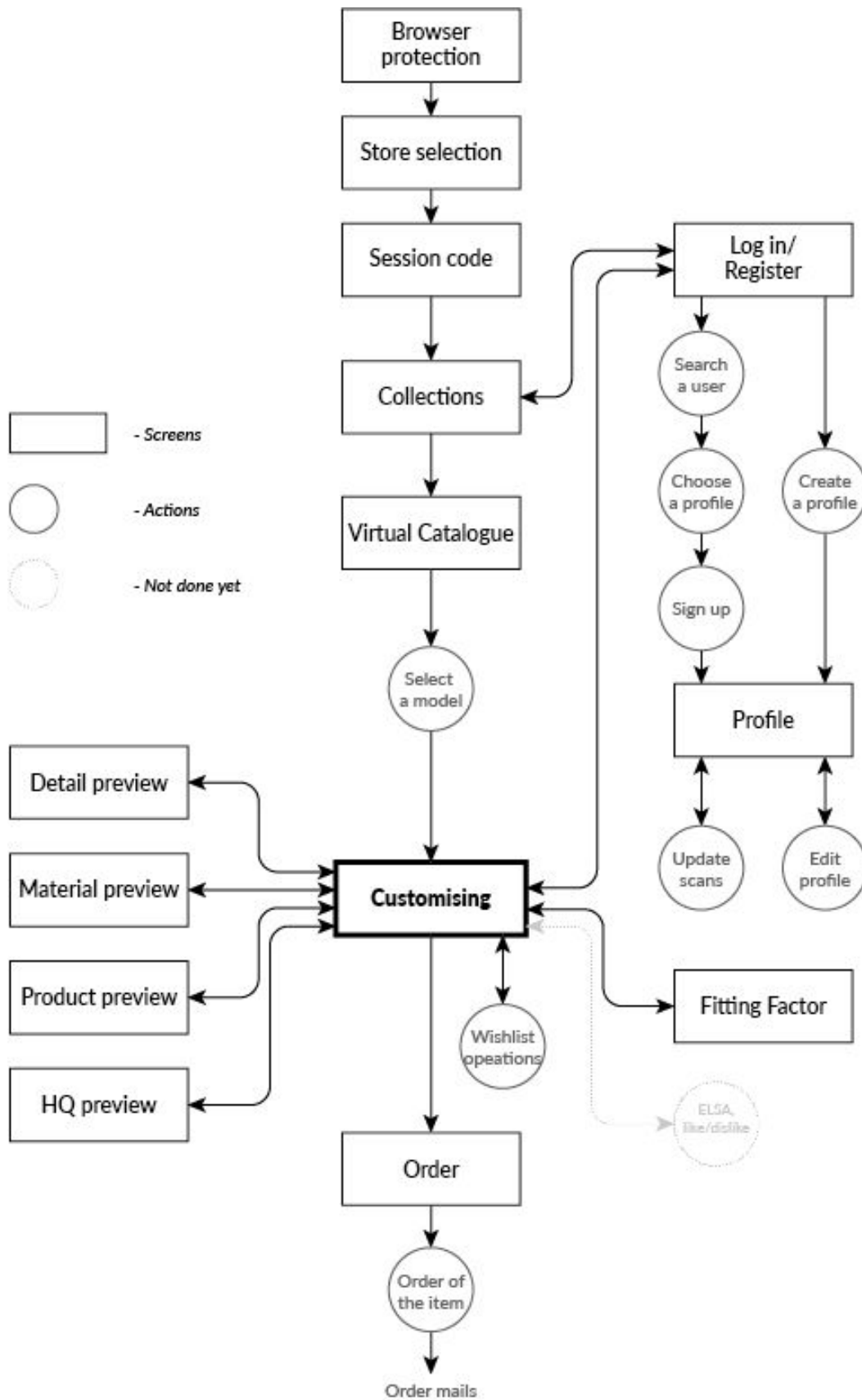
# 4.

# Virtual Assistant 'ELSA'

# Project definition

ELSA is a part of the project of the virtual 3D configurator (web-based 3D configurator and AR/VR unity-based configurator) by ELSE Corp. The Virtual assistant is based on the technology of Artificial Intelligence of Microsoft, Azure-based AI platform.

**Virtual assistant Elsa** (from E.L.S.E. - exclusive luxury shopping experience) is a virtual assistant being developed in base of artificial intelligence by ELSE Corp. The assistant's role is to help to the customers to make a choice while using the cloud based configurator.
The cloud based web configurator is one of the main products of ELSE Corp.

The virtual assistant is presented on the following steps of the 3D virtual configurator

- Virtual Boutique 3D app
- Virtual Catalogue 3D
- 3D Configurator (the main Configuration page)

# Technological aspect of Virtual assistant

Machine learning models need to consume a lot of the right training data.
The potential of computers is being growing year by year. The last years many producers of hardwear started to concentrate on the

Some universities have already created new programs for studying the building of hardware for deep learning and artificial intelligence support. For example MIT opened a new course: 6.S082/6.888 (Hardware Architecture for Deep Learning).

**The virtual assistant ELSA is a part of ELSE SDK.**
A software development kit (SDK or devkit) is typically a set of software development tools that allows the creation of applications for a certain software package, software framework, hardware platform, computer system, video game console, operating system, or similar development platform. To enrich applications with advanced functionalities, advertisements, push notifications and more, most app developers implement specific software development kits. Some SDKs are critical for developing a platform-specific app.
It could be something as simple as the implementation of one or more application programming interfaces (APIs) in the form of on-device libraries to interface to a particular programming language, or to include sophisticated hardware that can communicate with a particular embedded system. Common tools include debugging facilities and other utilities, often presented in an integrated development environment (IDE). SDKs also frequently include sample code and supporting technical notes or other supporting documentation to help clarify points made by the primary reference material.

ELSE SDK contains a number of libraries (based on the javascript language) responsible for the correct operation of the following modules:

- General structure and mapping of the application
- 3D scanning and scans integration
- Work with imported 3D models of shoes (correct display of models and the possibility of its configuration)
- Mechanism of Virtual fitting
- Managing of the CMS module, connection with Magento (Magento is an open-source e-commerce platform written in PHP. The software was originally developed by Varien, Inc, a US private company headquartered in Culver City, California, with assistance from volunteers.)

There are even some do-it-yourself VCA options that build upon technology created by some of the biggest names in IT, including Microsoft, Amazon and IBM.

**Microsoft AI platform**

ELSE Corp has benefitted from the Microsoft BizSpark acceleration programme, through which Microsoft supports new businesses by offering software, cloud, technological support, and visibility. The company works on the design and development of a technologically advanced Cloud SaaS & API platform and the related know-how about its key concepts: Virtual Retail and the Real Time Fashion System. In fact, the ambitious goal of ELSE Corp, consists of a Fashion Retail industry revolution based on these two principles, in two different directions, which are an integral part of the strategic vision of the startup:

Virtual Retail: an innovative hi-tech industrial process for 3D CAD & Cloud based Mass Customization of fashion products. It transforms brand distribution channels into new concept spaces within brick and mortar stores (shop in shop, popup & temporary shops) named Virtual Fashion Corners, where a 'new customer experience' of Virtual 3D Shopping, focused on product personalization can be easily realized. It represents a turning point for future methods of retail and manufacturing, providing new innovative strategies for the sales, design, production, distribution and marketing of fashion products.

Real Time Fashion System: enhances the customer's virtual shopping experience and optimizes the Virtual Retail production chain through the use of AI, machine learning, deep learning & procedural modeling. Driven by the integration of 3D & 2D CAD systems and Artificial Intelligence, which leadto accurate predictions of the style and size needs of individual customers, and guarantees the real-time demand planning and forecasting. It is a vision for a new product design process for companies and independent designers, that leads to the precise prediction of individual needs and product demand while improving the social and environmental impact of the fashion industry, on a global scale.

Microsoft technology supporting "virtual retail" innovation for the digital transformation of the fashion world
ELSE Corp's idea is to effectively merge the advantages of online shopping and physical shopping: the "3D Virtual Boutique" allows the user to view the entire collection and to choose in 3D, for each specific model, a whole series of finishes and details. The solution is based on Microsoft cloud computing and can be perfectly integrated into the environments of any fashion reality, enabling a customized solution for every brand, retailer or manufacturer. Several companies are already

experimenting with this path, which allows customers to customize their purchases by choosing color, fabric and details through ELSE Corp's technology. Among those who have already made their projects public, there are the emerging designer Michela Rigucci, the first to use this solution in 2016, and then in 2017 the well-known brand Thierry Rabotin joined in, followed by the trendy Faceshoes project and most recently by the luxury brand of Made in Italy quality Leonardi Milano, just to name a few. The E.L.S.E. platform in fact, promotes the concept of large-scale personalization, bringing the value of craftsmanship in the era of mass production and setting new parameters for luxury & fashion consumer retail.

The E.L.S.E. infrastructure is built on the Microsoft Azure cloud platform and the middleware and front-end solution leverages Azure's various modules and architecture of microcredits for the creation of the "Universal 3D Product Configurator", which integrates visualization and real-time 3D personalization. A front-end module for Augmented Reality is also available on Windows 10 tablets, and the shopping experience has been enabled through the Microsoft HoloLens mixed reality holographic computer, which allows you to interact with holograms projected in the real world and to see the finished product and the performance of models in different contexts, from casual to posh. ELSE Corp is also developing the new features of the E.L.S.E. platform, focusing on Microsoft's machine learning and cognitive services, to intercept market trends and anticipate customer needs in order to better plan production and optimize the entire supply chain. It is an ongoing project that aims to improve real-time forecasting and understanding of the needs of individuals, to optimize the global impact of the fashion industry and to introduce a sustainable perspective for the fashion system.

Looking back at the last year

In these past few months, ELSE Corp has made great progress: in 2017 alone, the startup has participated in dozens of important events, both B2B and B2C, allowing its innovative ideas and the values on which it is based to spread. In particular, the startup took part in the Microsoft Forum 2017 in March where they presented the future of shopping, offering visitors the chance to experiment with their in-development "3D Virtual Boutique". Following a succession of significant events related to Retail, e-Commerce and Mass Customization, it was precisely at theMICAM, the international B2B exhibition dedicated to footwear, that took place in Milan this September, that ELSE Corp along with its main business partners officially launched else.shoes ™ on the market; their innovative platform for the footwear industry, the result of more than two years of technological research and numerous tests and pilot projects. An outcome that was positively received at the "Tech Couture & Virtual Shoes: Discussions about Fashion and Technology" event organized in Moscow by Microsoft Russia on 29 September, and considered by the startup as its own official pre-launch on the Russian market & CIS.

**Partners**

During this long journey of "learning by doing", ELSE Corp has been able to forge strong partnerships with important industrial partners, such as ATOM Lab, Atom's research laboratory that develops experimental technologies and projects to create new production methods, and ShoeMaster UK, the world leader in CAD/CAM systems, offering 2D and 3D solutions for the footwear industry, as well as technological partners such as Predit, a startup whose mission is the design, development and marketing of enterprise solutions for Fashion and Retail, to simplify the development of new products and maximize the attractiveness of collections with predictive analytics; and with several system integrators such as Accenture, Techedge Group, VAR Group, Universities and International Research Centres. Furthermore, the startup has the opportunity to work closely with the true pioneers – brands, retailers and designers who have decided to take the first big step towards a new way of conceiving the Fashion System.

*Fig. 14, Microsoft AI platform*
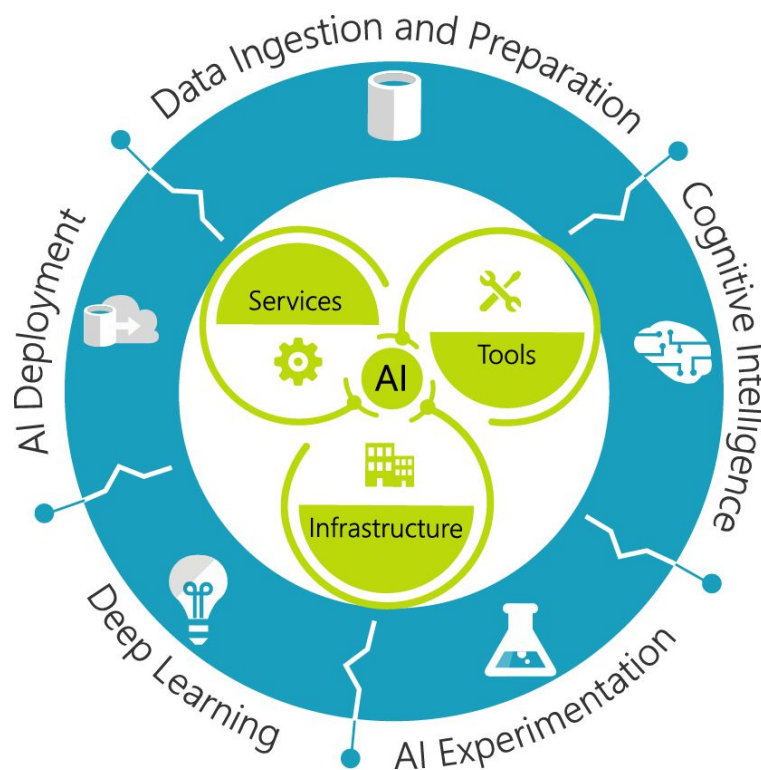


The AI solution for ELSA Virtual Assistant and its interaction with user is based on the **Microsoft AI platform**.

Azure offers a comprehensive set of flexible AI services for any scenario and enterprise-grade AI infrastructure that runs AI workloads anywhere at scale. Modern

AI tools designed for developers and data scientists help you create AI solutions easily, with maximum productivity.
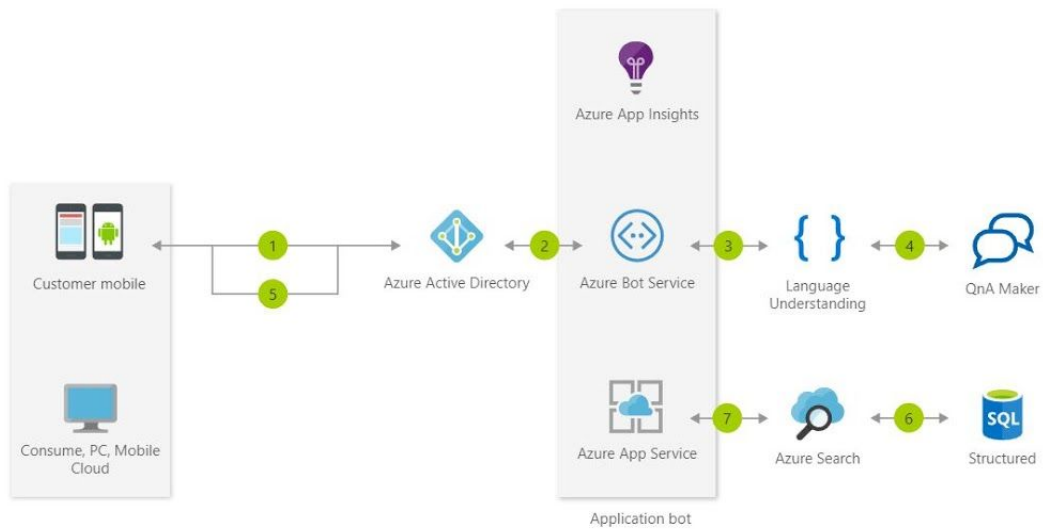
AI services

AI services allow to accelerate the development of AI solutions with high-level services, use preferred approach, adapted to targeted scenario, and achieve maximum productivity and reliability.

# Opportunities for development

Based on the research described in the previous chapters, we started to develop the scenario compatible with the programming solution of ELSE Corp. Our analysis allowed us to identify a number of important recommendations for creating a virtual assistant in the software environment of ELSE Corp.

**Short review**
The virtual assistant of ELSE Corp is a part of the 3D product virtual configurator which is the company's main product and which has been developed over the past three years.
The virtual Assistant is designed to help the customer with a choice of style and size, and to simplify and enrich the user experience.

**Language**
The 3D virtual configuration has English as the default language. For today it also supports Russian and Italian localisation that can be switched and set for every potential client.
Due to the breadth of the potential market for the main application, it is recommended to use the ability to simply select a language for the virtual assistant without having to reinstall it.
The basic set of languages should include **English** as the main language, **Italian** language as the main market one in any case.

**Available platforms**
According to the research of BrandGarage and Linc [BrandGarage and Linc, 2017] the following conversational channels will be most important to business in the next 24 months:

Website Live Chat **65.3%**
Facebook Messenger **51%**
In-app Live Chat **34.7%**
iMessage 24.5%
Amazon Alexa **16.3%**
WhatsApp 14.3%
Google Home **6.1%**
Siri 2%
Other 22.4%

As can be seen from the statistics, most of the channels under certain conditions can be supplemented by virtual assistants.

The virtual assistant for else corp is implied as being built into the application (both instore and online). In this case the Virtual assistant platforms are integrated in forms of **In-app assistant** or **website chat bot**.

However, it is worth considering also the support and integration of other channel communication.

**Methods of interaction and type of input**

Interaction is determined by a **set of actions** (a number of **patterns** inherent in the standard behavior of buyer) and the **data** necessary for analysis by artificial intelligence.

Despite the obvious convenience of voice communication, some things should be duplicated or supplemented with a GUI as well. For example, the order confirmation should be displayed graphically because it has much information about the customer order that can not be reflected only in the audio format.

Also, some actions may require graphical display. For example, the client's signature.

So the virtual assistant should use at least two methods of interaction: **speech** and **graphic interface** to provide seamless experience to the customer.

**Functions and roles**

The roles of the Virtual Assistant for the virtual 3D configurator are:

- **Collection** the data for deep analysis;
- **Suggestion** the style/model to a user according their previous decisions;
- Making the experience with the application easier and more comfortable using a series of suggestions and tips (for example the Virtual assistant can **"lead" the customer** flow to create a perfect experience based on the type of character and behavior of the user;
- **Support** of the user if he/she has questions or doubts through a text or voice dialogue

Proceeding from the aforesaid we can define the functions of the virtual assistant.

**Functions of the Virtual Assistants**

Virtual Assistants can also be classified by content-oriented functions as

- **Support**: Virtual Assistant helps to solve current problems and issues with a service or product

- **Instructions**: Virtual Assistant gives direct instructions to the user to solve issues or thain the usage of the product.

- **Control**: Virtual Assistant helps manage the product or service

- **Catalogue**: Virtual Assistant helps to find and sort the items

**Humanoid interface and its properties**

The image of the Virtual assistant is being building based on the research (see chapter 3) and the cloud of cases and examples of the successfully realized virtual assistants.

It should correspond to the customer expectations about a perfect *assistant*.

So the Virtual assistant should look like and be:

- **Woman.** It should be "female" interface. As was explained earlier customers tend to trust the female personage more.

- **Adult.** The interface should correspond to the age of potential target clients (middle-age, 35~55 years), it absolutely can not be a teenager, neither too old person. The perfect age is the age of young professional: to give the confidence in the right choice of the Virtual assistant.

- **Restrained.** Too active, intrusive behavior will not inspire confidence in the consumer. The same applies to clothes: the appearance of the assistant should be elegant and should not be colorful of eccentric

**Interaction**

The interaction between the Virtual Assistant and user is carried out through the **speech** or graphic interface in the form of the standard web forms.

**Dialogue structure**

Based on the goals and tasks of the virtual assistant the dialogue structure should include:

- **Answer** (user)-**question** (assistant)
- **Tips and advices** during the process of customization

**Customization**

Despite the fact that each brand has its own application interface, the interface of the assistant should always correspond to the identity and brand style of ELSE Corp.

**Seamless experience and the integration with the platform**

The assistant should be a deep integrated part of the 3D configurator providing seamless experience to its user. The existing structure and technology of the application dictates the further development of the project.

**Principles and patterns of interaction between VA and customer**

The actions defined for the web-based configurator are following:
The data that is used for analysis by artificial intelligence:

- **The level of comfort** (default pre-made database by ELSE Corp + new anonymous data from users)

- **Style suggestions** as 'You might also like: ...' based on data from 'Like-dislike' function (by user) and predefined suggestion settings (provided by ELSE Corp or by brand)

ELSA should use the prepared datasets with the existing parameters (given by ELSE Copr according to the research) to learn the correlations between style, accessories, materials, and other parameters of the shoes to be able to recognize the taste (as a collection of user preferences and his/her ideas about the style) and preferences of potential customers.

As the first step (basic level) ELSA is able to define in base of some parameters of both the base model and the current configuration the following conclusions:

- **Occasion and usage:** casual, event, special, office, formal, etc

- **Weather:** waterproof, comfort, inside usage, etc

- **Base model** of a brand collection

- **Styles:** classic, english, chic, sport, luxury, modest, traditional, etc

- **Accessory:** as details: straps, laces; or extra: stones, monograms

- **Material and color:** suede, leather, fabric, etc

Based on the basic patterns the virtual assistant should be able to understand more complex and abstract customer requests, for example:

**"Please choose a soft natural material for it"** that should be internally interpreted as the sequence of following actions:

*"Find natural materials"*

*"Find soft materials"*

*"Find the materials available now for this model"*

*"Choose one of the previous options"*

# Constraints and restrictions

## Technology

The cloud technologies are growing up really fast and provide new and more powerful solutions. However, today we can only use solutions available on the market at the moment.

The size of computer for the virtual corner should not exceed 25x25x5cm. The existing solutions has limits of the computing power in the level of Intel Core i7 processor and integrated graphic cards. Whereas the maximum of the RAM is 32Gb.

The choice of monitors is wide enough. But the existing color profiles do not cover the whole variety of real colors. It means the configurator can not show the real colors and textures of the materials.

## Development prospects

Despite the limitations in technology today, we must provide opportunities for the growth and development of the assistant and his functions. It is necessary to react flexibly and quickly to market demands, offering new conceptual solutions, prototyping and introducing new functions and opportunities.
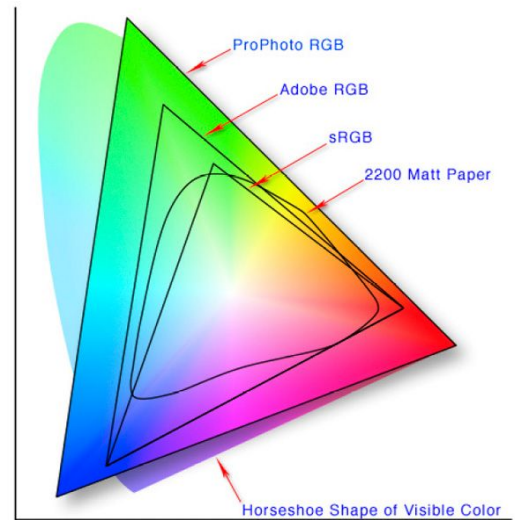
# Conclusion

Artificial intelligence is firmly fixed in our lives. The number of virtual assistants is increasing every year, and the scope of their application is expanding. The quality of their work is not inferior to the human, and the speed has long surpassed it. Moreover, users become more loyal and happy to use robots in the daily life services and retail.

This paper is a research and case analysis of the existing virtual assistants which have been designed for the industries of banks, healthcare, retail etc. It analyzes the appearance, interface, functions and user experience of the most famous virtual assistants. It aims to summarize what is needed to design an new virtual assistant based on the existing software solution (virtual configurator) ELSE corp.

During the in-depth analysis of 32 virtual assistants, the features, commonalities and differences between them were elucidated. Tables and diagrams showing the features of the work and functional were also compiled, and an in-depth analysis of the most significant of them was conducted and illustrated.

Obviously, all available assistants have their own individual characteristics and similarities, and a virtual assistant for retail will have its own characteristics. If we want to create a successful product, we need to understand not only the technological principles and mechanisms of work, but also the user preferences regarding the appearance, experience and character of the environment.

First of all, we must take into account that the virtual assistant is not yet a replacement for a living person, but only a "feature" and some help, since the virtual assistant functionality assumes a script for working with the user, even if this script is flexible.
It is also important to understand that the use of a virtual assistant should enrich the user experience, leaving it seamless. But never impoverish it. Therefore, such a step as the introduction of a virtual assistant requires a careful study of possible risks.

In our study, we attempted to sanctify not only the positive aspects of virtual assistants, but also the shortcomings that can still be present.

In the end, we also considered the technologies and principles of the current application to understand the most effective implementation of a virtual assistant in its environment.

The research we have done does not exhaust all aspects of the interaction between client and virtual assistant in retail and requires further research. The problem of human interaction and artificial intelligence is extensive and goes beyond a single scientific discipline. The solution in the short term, in our opinion, lies at the intersection of design, engineering, psychology and linguistics.

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# Glossario

**Emergent machine society** is the ability of the machines to talk to each other using conversational interfaces by the conventional building blocks

**Virtual assistant (VA)** is a conversational, computer-generated character that simulates a conversation to deliver voice- or text-based information to a user via a Web, kiosk or mobile interface via an ongoing two-way dialogue . A VA incorporates natural-language processing, dialogue control, domain knowledge and a visual appearance (such as photos or animation) that changes according to the content and context of the dialogue. The primary interaction methods are text-to-text, text-to-speech, speech-to-text and speech-to-speech.

**Chat bot (or customer-facing chat bot)** is a computer program or an artificial intelligence which conducts a conversation via auditory or textual methods

**GUI (graphical user interface)** is a type of user interface that allows users to interact with electronic devices through graphical icons and visual indicators such as secondary notation, instead of text-based user interfaces, typed command labels or text navigation

**Design-driven innovation** is an approach to innovation based on the observation that people do not just purchase products, or services, they buy 'meaning' – where users' needs are not only satisfied by form and function, but also through experience (meaning).

**CUI** (conversational user interface) is  he ability of artificial intelligence-supported chatbots to have verbal and written interactions with human users.

**VCA** Virtual customer assistant

**VPA** Virtual personal assistant

**ML** (Machine learning) is a subset of artificial intelligence in the field of computer science that often uses statistical techniques to give computers the ability to "learn" (i.e., progressively improve performance on a specific task) with data, without being explicitly programmed.

**NLG (natural language generation)** is the natural language processing task of generating natural language from a machine representation system such as a

knowledge base or a logical form. Psycholinguists prefer the term language production when such formal representations are interpreted as models for mental representations.

**NLP (Natural language processing)** is an area of computer science and artificial intelligence concerned with the interactions between computers and human (natural) languages, in particular how to program computers to process and analyze large amounts of natural language data.

**Neural Networks** is a system of hardware and/or software patterned after the operation of neurons in the human brain.

**Semantic Understanding** is the ability of the conversational interface to understand the sense of the context.

**Text-to-speech** is the artificial production of human speech.

**Speech recognition** is the process of enabling a computer to identify and respond to the sounds produced in human speech.

**AI** artificial intelligence

**CAI** conversational artificial intelligence

**IE** inference engine

**NLP** natural-language processing

**NLQA** natural-language question answering

**VCA** virtual customer assistant