



intetics

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# Unlocking AI: Transforming Enterprises in the Digital Age



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# Introduction

Welcome to the future—a future where Artificial Intelligence (AI) is a reality of business operations. The scope of AI is huge; it can range from improving productivity to enhancing customer support. In this eBook, we will explore real-life projects and ideas on how to apply AI within your organization and across different industries to achieve efficiency and innovation.

Imagine a world where your enterprise no longer struggles with the inefficiencies of manual processes. Routine tasks that once drained valuable time and resources are now automated, allowing your teams to focus on strategic initiatives. Decision-making is no longer hampered by a lack of data; instead, AI-driven insights deliver actionable, real-time recommendations. This isn't a futuristic fantasy—it's the reality for businesses that are embracing AI today.

But this eBook isn't just about the technology—it's about transformation. We'll guide you through the practical steps to implement AI within your organization, highlighting real-world projects and offering insights into how to tailor AI solutions like EKA to meet your unique needs. The possibilities are limitless, from enhancing customer service to improving compliance and risk management.

Intetics Inc. is a leading American technology company providing custom software application development, distributed professional teams creation, software product quality assessment, and "all-things-digital" solutions built with SMAC, RPA, AI/ML, IoT, blockchain, and GIS/UAV/LBS technologies. Based on proprietary pioneering business models of Offshore Dedicated Team® and Remote In-Sourcing®, an advanced Technical Debt Reduction Platform (TETRA™) and measurable SLAs for software engineering, Intetics helps innovative organizations capitalize on global talent with our in-depth engineering expertise based on our Predictive Software Engineering framework. You can find more information at <https://intetics.com/>.

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Chapter 1

# **Conversational AI for Business**

(#Chatbots #GenAI)

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# Conversational AI

The new era of the  
human-like automated communication.

## Objective

Conversational AI falls under the Artificial Intelligence domain; this application deals with text-based or speech-based AI agents that are able to simulate verbal interactions and conversations. The proliferation of voice assistants, chatbots, and other conversational AI agents can be attributed to two major developments.



The first: deep learning and machine learning are required to develop very accurate AI models. Such learning methods have advanced significantly in recent years – this is due to higher research interest in these areas alongside improvements in computing power (with the help of TPUs, GPUs, and other specialized hardware).

The second: because of the nature of conversational AI's design and Natural Language interface, they can naturally fit into many applications like customer service, healthcare, education, and e-commerce. Now, more than ever, conversation AI is an innovative field, full of novel research, heightened practical implementation, and robust demand.

New, complex models for Conversational AI's individual architectural core components are being developed and introduced at a rapid rate. In this whitepaper, we will bring your attention to the most up-to-date research regarding Conversational AI architecture development. What's more, we will show the advantages that Conversational AI has over its traditional counterparts.

## What Is Conversational AI and How It Works?

Conversational AI brings together messaging apps, speech recognition, and artificial intelligence. It is designed to enable software to interact with people using intuitive, natural languages. Businesses can use conversational AI to deliver personalized, automated communication experiences.

Software that combines the above-mentioned three features, using them to carry on a simulated (even human-like) conversation, could be called a "bot." Text-only bots are referred to as "chatbots."



If you have used Amazon Alexa, Google Assistant, or a similar virtual assistant, then you have experience using conversational AI. The conversational experiences provided by such "assistants" are maturing due to deep learning. AI bots are moving away from rule-based decision trees – rather than being based on if/then logic, they now learn as they go. Conversational AI bots can identify the user's intention and the situation's context – thus, they are better able to deliver an experience tailored to the user's specific query. As such, conversational interfaces are ever-evolving, aiming to deliver helpful, enjoyable user experiences.

And how can those experiences be rich and useful? Imagine that your customers have access to a smart assistant, which can communicate and empathize with them, understand their needs, and provide assistance accordingly. A conversation like this can help bring the user closer to the final action more quickly than a menu, touch screen, or mouse click ever could.

Integrating conversational AI throughout automated, customer-facing touchpoints can negate the need for click-driven interactions. Customers no longer need to sort through pages of information to find the answer they need.

## The Scope of Conversational AI

The AI-human relationship has not yet reached its fullest potential. However, scientists have been experimenting with machine learning so that computers can be provided with as much context as possible. There are two specific techniques used to accomplish this:

- 1**  
**Reinforcement learning**  
(trial and error)
- 2**  
**Supervised learning**  
(teaching with examples)

Due to the continuous advances in cognitive technologies, it is becoming possible to give customers more accurate and relevant dialogues – thus, conversational AI solutions are more commonly used within B2B and enterprise applications. You can find conversational AI used in all sorts of niche services. Nowadays, bots are able to schedule appointments, answer queries about services and products, and even provide additional resources to users – essentially, they can virtually eliminate the need for a "real live" operator. It is highly likely that future conversational AI applications will provide personalized assistants that can predict user needs – not just fulfill them.

## Why Is Conversational AI Important for Your Business?

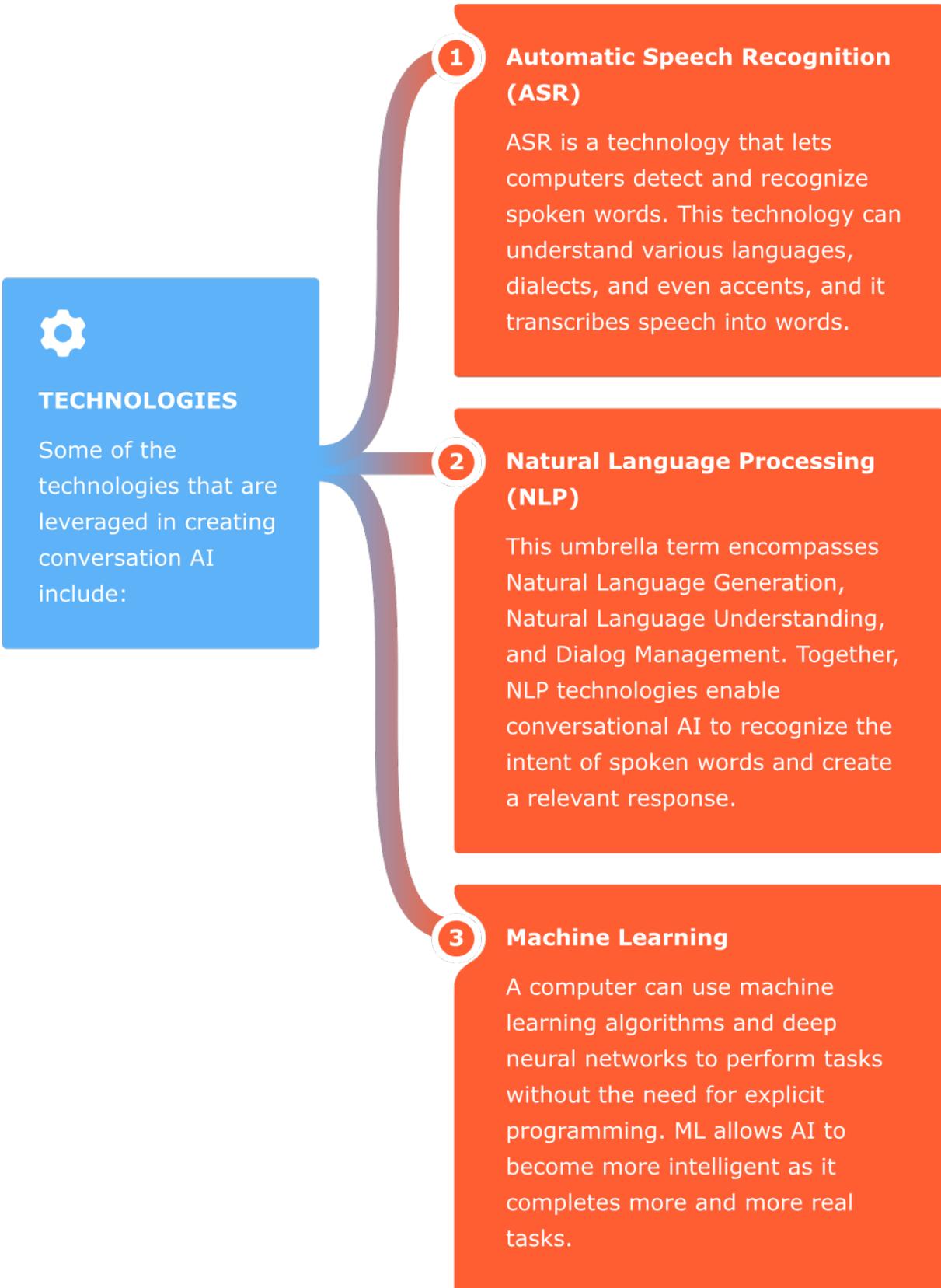
Why is there such a strong drive for the adoption of conversational AI? It is driven by a dual mandate: while it's true that brands want to cater to their customer's needs, they also need to stay innovative so they can have a large share within a competitive marketplace. Conversational AI holds the answers to both goals: it empowers brands to provide an intelligent, personalized, and superior user experience in an innovative way.

When a business uses automated conversations to engage with customers, it can easily scale that experience across several devices, platforms, and channels, effectively catering to the whole user base. Conversational AI solutions can be interwoven throughout all touchpoints – social media, mobile apps, messaging platforms, websites, voice-based assistants, and more – in order to facilitate a friendly, easy, and seamless experience.

There are various other reasons that organizations worldwide are diving into Conversational AI, including:

- **Time savings for the customer:** Customers can receive quick responses, and they don't have to go through the hassle of waiting on hold for answers to generic questions.
- **Increased organizational efficiency:** Typically, high call and email volume take a large toll on customer service teams. But, with conversational AI, this is no longer the case. Companies can leverage lowered customer acquisition costs and automated operations to place a priority on other business functions.
- **Simple, real-time access:** Customers can use the channel of their choice to seamlessly connect with a chatbot. What's more, the conversations are synchronous across devices, so there is a lowered risk of information discrepancy.
- **Online relationship management:** Brands can manage social media engagement and interactions via personalized, synchronized conversations.
- **Lowered complaints:** Because sales questions can be answered before the actual transaction, friction during the buying process is reduced.
- **Management of the customer cycle:** A customer can place an order, get detailed information about the purchase, and receive after-sales information. The entire loop is covered by conversational AI – from seeking information about a product to delivering product feedback.
- **Increased collective intelligence:** Conversational AI technology is able to track shopping patterns, monitor customer data, and use the results to deliver the best real-time, personal support. As more customers use the bot, the interactions will only get better.
- **Lowered cart abandonment rate:** When customers have access to a persistent, forward-driving communication channel, they are ready to browse and buy more. Customers can also put the conversation on pause and return later without having to start the process again from scratch.

# Conversational AI Overview



## Market Leaders of Conversational AI



Siri, Alexa, and Google Assistant are all household names at this point, as they are the market leaders of conversational AI. However, there are several successful startups that have built similar products for their customer base. These include:

- **Kore.ai:** It lets enterprises automate their digital interactions with employees, partners, and customers. Kore.ai lets enterprises create their own virtual assistants or use pre-built ones for HR, banking, insurance, and IT Support applications.
- **Houndify:** This large-scale speech recognition and NLU solution helps brands develop custom voice experiences for any product. Some of Houndify's domain partnerships include Yelp, Uber, and Accuweather.
- **iSpeech:** It uses voice cloning technology, providing pleasant and familiar voices across a wide range of applications, products, and services. Some use cases include audiobook narration, voices in animated movies, celebrity voice cloning, navigation apps, and interactive training.

## Brief History of Development

We've included a list of chatbots organized by chronological progression – starting with ELIZA. While ELIZA was not AI-powered, it marks the start of chatbot development, so it is a necessary inclusion.

1960s

### The Very Beginning: ELIZA

MIT professor Joseph Weizenbaum developed the world's first chatbot in the 1960s, called ELIZA. Essentially, users would enter words into a computer, and ELIZA would compare them to a list of scripted responses. The script mirrored responses that psychotherapists might give, which led to users confiding their innermost thoughts to ELIZA.

As variants of this chatbot popped up at universities throughout the US, experts began to proclaim that chatbots would soon be indistinguishable from humans. However, Weizenbaum disagreed; he argued that chatbots were meant to be tools and that their understanding of speech is highly dependent on content – according to him, computers would never have a general understanding of human language.

1972

### PARRY

In 1972, American psychiatrist Kenneth Colby developed PARRY in an attempt to simulate a patient with schizophrenia. Parry used a complex system of attributions, assumptions, and "emotional responses" that were triggered by variable weights attached to verbal input. The Turing test was used to validate the system; testers were unable to distinguish PARRY from human schizophrenic patients with more than random accuracy.

1988

### Jabberwacky

British developer Rollo Carpenter created Jabberwacky in 1988, which aimed to simulate natural human conversation via contextual pattern matching. Unlike more traditional conversational AI, Jabberwacky wasn't used for corporate representation or for computer support systems – it didn't really go beyond a form of entertainment.

1992

### **Dr. Sbaitso**

Dr. Sbaitso, created in 1992 by Creative Labs, was one of the first attempts to incorporate conversational AI into a chatbot. The program took on the persona of a psychologist; when it interacted with users, it would give responses like "Why do you feel that way?"

1995

### **ALICE**

ALICE, which stands for Artificial Linguistic Internet Computer Entity, was pioneered by Richard Wallace in 1995. This chatbot used heuristic pattern matching to hold rudimentary conversations, albeit ones that were unable to pass the Turing test.

"Alice" has the appearance of a young woman, and she is able to converse with the user – she provides facts about herself (such as her age, hobbies, and so on) and can answer the user's dialog.

2001

### **SmarterChild**

Developed in 2001 by ActiveBuddy, SmartChild can be considered Siri's precursor. It was available on MSN Messenger and AOL IM, and it had the capabilities to carry on fun conversations while also providing information on the news, weather, stock information, sports matches, and more.

2010

### **Siri**

Siri was a groundbreaking AI bot that was developed for Apple's iOS in 2010; it paved the way for all future conversational AI bots. While Siri's capabilities have certainly evolved since 2010, it was originally designed to be a "do bot" – in other words, users could hold conversations with the Internet, and then Siri would make a decision and perform an action based on the conversation.

2012

### **Google Now**

Google Now was launched by Google in 2012; it is able to answer questions, make recommendations, and perform actions based on requests. Initially, Google Now's aim was to give users more contextually relevant information based on the time of day and their location. Now, however, it provides a wide array of information on "cards," using data pulled from the user's Gmail account.

This includes hotel and restaurant reservations, flight information, movie tickets, and more. Cards can also be created based on the user's search history.

**2014**

### **Cortana**

Cortana is another "do bot"; it responds to voice commands and performs tasks like sending texts and emails, setting up reminders, playing games, finding facts, and pulling up file locations. It was first demonstrated in 2014 at Microsoft's Build conference, and it has since been integrated into Windows 10 PCs and Windows phones.

### **Alexa**

Amazon introduced Alexa in 2014; it was built into the Amazon Echo device, but there is now an Alexa app that can be used on third-party devices. Users can give Alexa voice commands, and she will control your smarthome products, play audiobooks, set alarms, search the web, play music, and much more. Developers can even create and publish their own skills for Alexa.

**2016**

### **Launch of Google Assistant**

Google introduced Google Assistant, an AI-powered virtual assistant capable of engaging in two-way conversations, integrated into smartphones and smart home devices.

**2017**

### **Transformer Architecture Introduced**

Vaswani et al. published "Attention is All You Need," introducing the Transformer model, which relies entirely on self-attention mechanisms, revolutionizing NLP and forming the basis for future conversational AI models.

**2018**

### **Google Released BERT**

Google released BERT (Bidirectional Encoder Representations from Transformers), a pre-trained language model that improved many NLP tasks and enhanced conversational AI capabilities through better understanding of context.

**2020**

### **Introduction of Retrieval-Augmented Generation (RAG)**

Facebook AI Research introduced RAG methodology, enhancing conversational AI's ability to provide accurate and up-to-date responses by integrating external knowledge retrieval with generation models.

**2021**

### **Google Introduced LaMDA**

Google unveiled LaMDA (Language Model for Dialogue Applications), a conversational AI model designed to engage in open-ended conversations on any topic.

**2022**

### **OpenAI Released ChatGPT**

OpenAI launched ChatGPT, a fine-tuned version of GPT-3.5 optimized for conversational interactions, which gained widespread attention for its human-like responses.

**2023**

### **OpenAI Released GPT-4**

OpenAI released GPT-4, a multimodal model capable of processing image and text inputs, demonstrating advanced reasoning and problem-solving abilities in conversational contexts.

## Total Market Volume

According to the [2019 P&S Analysis on the Global Conversational AI Market](#), the industry's value in 2018 was \$3.2 billion. The Analysis predicts that the market will hit the \$15 billion mark by 2024, with a compound annual growth rate of 30.2%.

### GLOBAL CONVERSATIONAL AI MARKET



Out of all regions, North America had the biggest market share in 2018: 42%. This is attributed to several factors:

- Heightened technological advancements in the region.
- The presence of Google, Microsoft, Apple, and other conversational AI vendors.
- Increased investments in the integration of NLP and machine learning.

The same analysis found that chatbots count for the largest share within the conversational AI market – and their share will be over 45% in 2024. Their domination of the market is due to the increasing demand for chatbots within social media and the consumer preference for intelligent customer support.

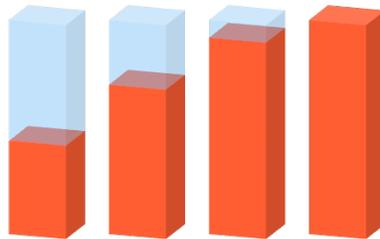
**GLOBAL CONVERSATIONAL AI MARKET ANALYSIS MARKET, EXECUTIVE SUMMARY**

- By Technology**
- Machine Learning and Deep Learning
  - Auromared Speech Recognition
  - Natural Language Processing

- By Technology**
- Customer Support
  - Personal Assistant
  - Branding and Advertisement
  - Customer Engagement and Retention



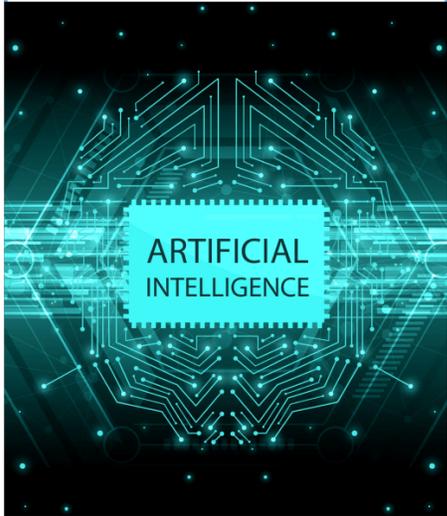
↑ @CAGR 29,8%



- By Geography**
- Overview
  - North America
  - Europe
  - Asia Pacific
  - Rest Of The World

- Company Profiles**
- Amazon Web Services, Inc
  - microsoft
  - Oracle
  - IBM
  - Google LLC

**GLOBAL CONVERSATIONAL AI MARKET ANALYSIS MARKET Opportunities and forecast**

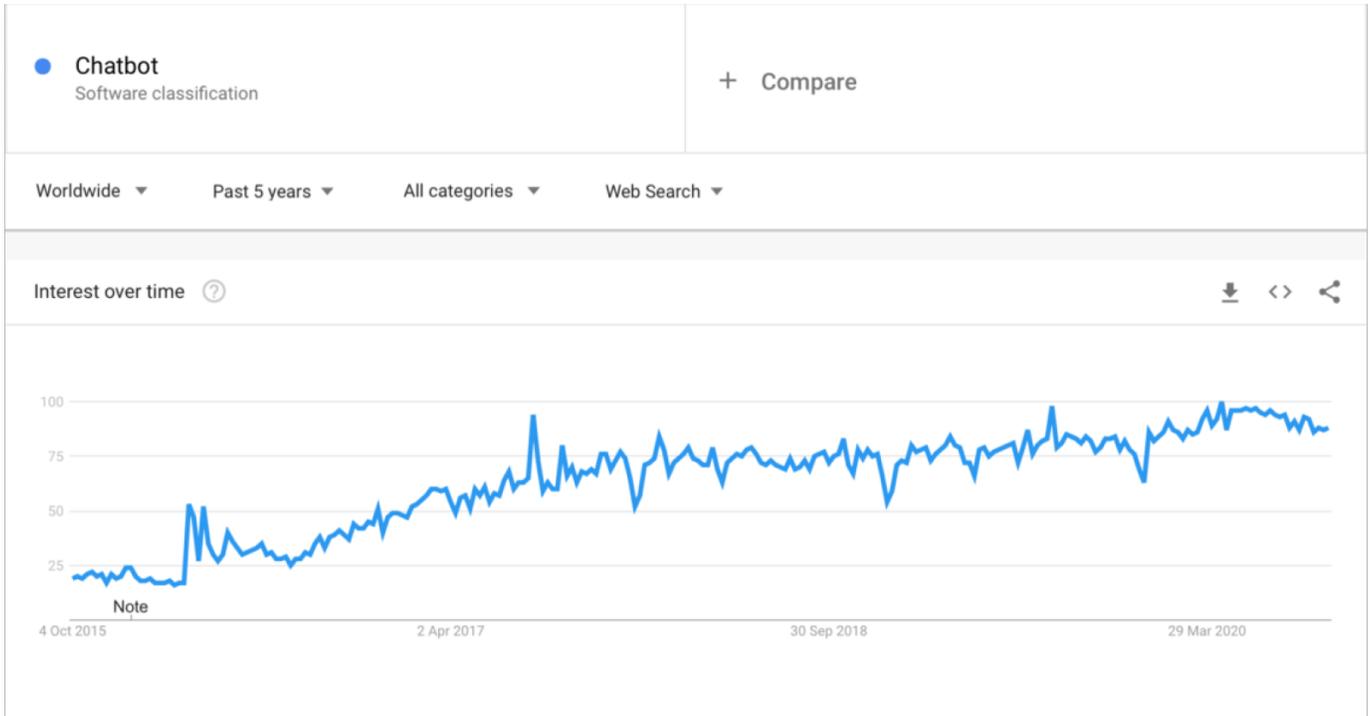


**Global Market is Expected to Rich**  
**US\$ 24.78 Bn**  
**by 2026**

**Growing at a CAGR of**  
**29.8 %**

## Expert Market Opinions

- According to a [study by Cognizant](#), the global chatbot market could reach \$1.25 bn by 2025, with a compound annual growth rate of 24%. The study found that 37% of AI startup founders believe virtual agents and chatbots will be the top consumer AI application.
- [Juniper Research](#) predicts that chatbot eCommerce transactions will have a value of \$112 bn by 2023.
- According to Google Trends, there has been a five-fold increase in chatbot interest during the last five years.



## Main Tech Components

Conversational AI combines machine learning with natural language processing (NLP). There is a constant feedback loop occurring between both facets in order to continuously strengthen AI algorithms. These principal components of conversational AI allow it to process and understand texts, as well as to create natural-sounding responses.

### COMPONENT 1: MACHINE LEARNING

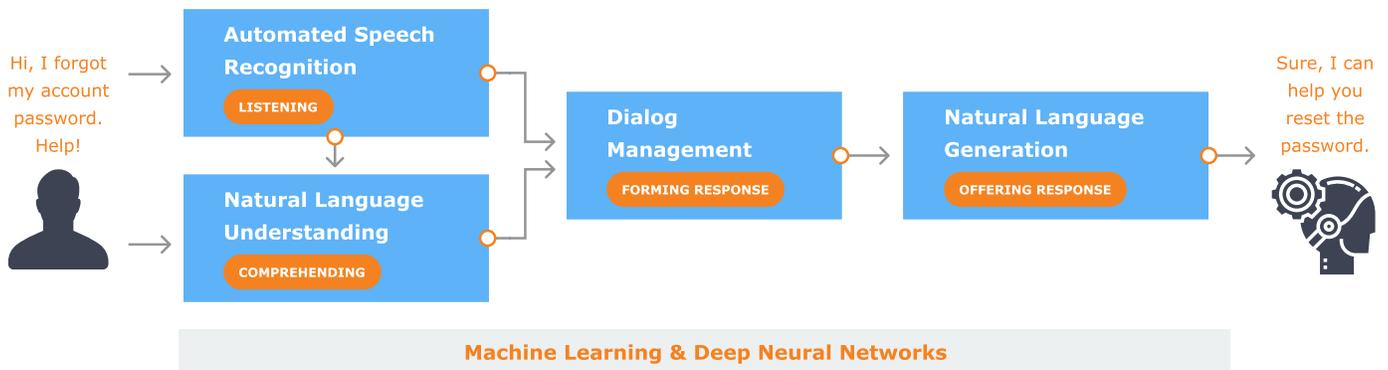
This sub-field of AI consists of a set of data sets, features, and algorithms that improve themselves over time. As the platform receives more input, the machine improves at pattern recognition and can use it to create more accurate predictions.

### COMPONENT 2: NATURAL LANGUAGE PROCESSING

This is when conversational AI analyzes language (with the help of machine learning). Breaking it down further, NLP has four steps: input generation, input analysis, output generation, and reinforcement learning. Throughout these steps, unstructured data is transformed into a readable format, which the computer then analyzes and uses to craft a response.

Let's take a closer look at the four steps of Natural Language Processing:

- **Input generation:** Users use an app or a website to provide voice- or text-based input.
- **Input analysis:** Conversational AI will use natural language understanding (NLUE) to decipher the meaning of text-based input. On the other hand, for voice-based input, the AI uses automatic speech recognition (ASR) in addition to NLU.
- **Dialogue management:** Natural Language Generation (NLG) creates a response.
- **Reinforcement learning:** Lastly, to improve accuracy, machine learning algorithms refine dialogue responses over time. This is often done by accepting corrections from end-users.



## Main Tech Architectures, Tools, Stacks Used

Nowadays, Conversation AI shows up in three main types of data products: chatbots, intelligent virtual assistants, and customer service assistants.



### Chatbots

This is certainly Conversational AI's most common application. They are often found in a website's FAQ section, and they are able to guide users through various website features - their main action is to deliver responses to a text query and guide the user to the relevant page. Chatbots will typically answer questions about topics like shipping and sizing, but they can also cross-sell products or even provide personalized advice. However, this is quite basic; these chatbots don't have deep-learning capabilities and, thus, cannot improve their future interactions.



### Intelligent Virtual Assistants

These are a more advanced application of Conversational AI; Amazon's Alexa, Apple's Siri, Samsung's Bixby, and Google Assistant all fall under this category. Some, such as Alexa, are used as home-based voice assistants, while others, like Bixby, are mobile assistants that offer navigation, address search, and quick reply capabilities.



### Customer Service Assistants

These applications target specific problems related to business services; their goal is to provide customers with efficient and relevant support. Bad customer service is directly correlated to a loss of customers; using well-developed AI customer service assistants will help increase client buy-in. Better support = higher customer satisfaction.

## Consumer Reaction to Bad Customer Service



**1/3**

of consumers would consider switching companies after a single instance of bad customer service.



**27%**

of US customers say that ineffective customer service is their top frustration.



**72%**

of consumers say they have to explain problems to multiple agents as poor customer service.

## How to Choose the Right Conversational AI Solution

While you can use custom AI options for your website, including AI chat interfaces, we are going to look at pre-built solutions that you can deploy today. Pre-built solutions are quick and easy to use, and there's the added benefit that they are already on familiar platforms.

### Chatbots

---

There are plenty of pre-built, text-based chatbots to choose from for platforms like Twitter, Slack, and Facebook Messenger. The first thing to do is choose a platform that your customers already use – or are at least familiar with – and make sure it includes the necessary features.

How do you go about choosing a platform that your customers use? Check to see which are already using to get in touch with your staff. You can also do demographic research to find out if your customers would prefer to use other channels.

Next, decide if you want the entire experience to be automated via chatbot. The alternative is for the chatbot to automate the beginning of the conversation and then route the customer to a human employee.

Lastly, check to make sure the platform has robust security, social media integration, and any other features you'd like to prioritize. These features can make or break the customer experience; by utilizing quality-of-life features, you can tap into customer service psychology and cultivate a successful platform.

### Voice Assistants

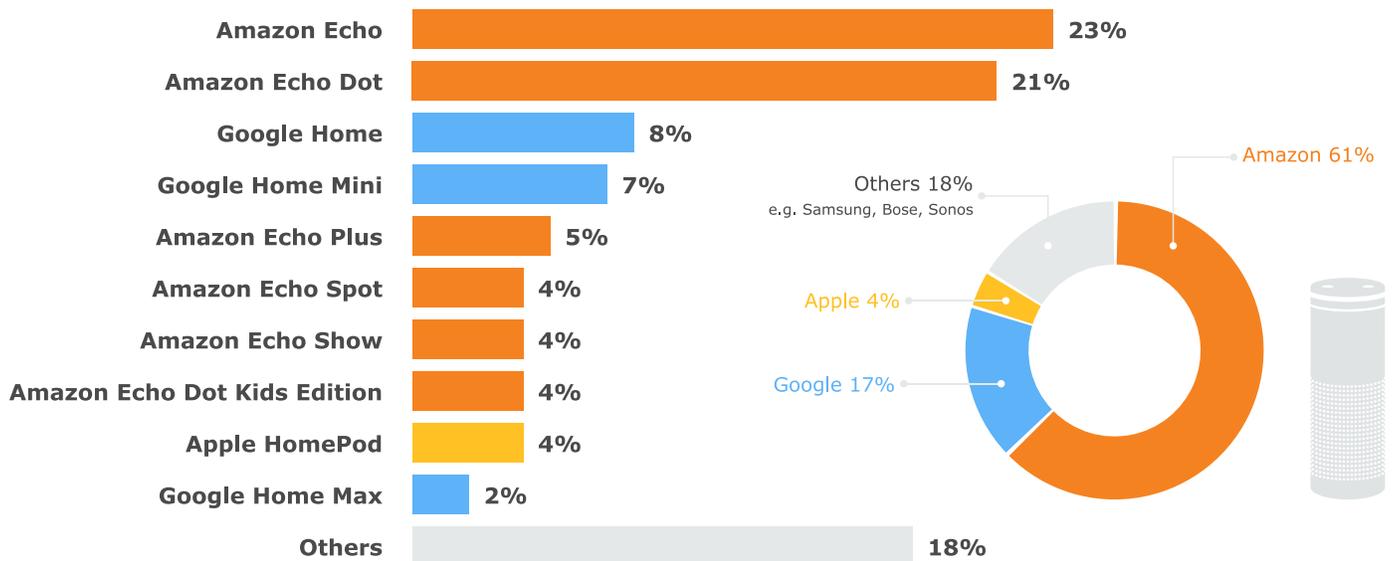
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If you are going to use a voice interface, you can select a pre-built voice assistant or a smart speaker platform. Again, it is important to choose a platform that your customers are familiar with.

While the industry leader of smart speakers is Amazon, smart speakers use the same platform as smartphones. So, even though Apple's HomePod only had a 4% market share, its compatible device (iPhone) has a 45.2% share of the US smartphone market.

## Amazon's Alexa Rules American Smart Homes

Most popular smart speakers in the United States in Q3 2018 (share of active devices)\*



\* based on a survey of 1,011 users of smart speakers in the U.S. conducted in July/August 2018

Source: Strategy Analytics

## Why We Recommend Predesigned Packages

When you use packages that are predesigned to address certain requests (FAQs, dialog forms, etc.), chatbots can process standard queries automatically and abnormal questions on a case-by-case basis. With such packages, chatbots can:

- Process information procedures
- Route customers to customer service representatives if necessary
- Handle standard customer interactions

It's important to note that AI chatbots are not yet able to handle every task on their own; they are used to supplement a customer service team rather than replace it. Furthermore, because basic chatbots don't have deep-learning capabilities, it is necessary for content managers and dialog experts to work on improving chatbots manually.



## Main Applications and Impact Delivered

As mentioned above, the most common use case of conversational AI is voice assistants and online chatbots, with a focus on omnichannel deployment and effective customer support delivery. Most conversational AI applications can deliver human-like conversations and collect extensive analytics for improvement purposes.

However, this application can be considered as "weak AI," as these assistants and bots are focused on a narrow range of tasks. Strong AI, conversely, focuses on solving broad problems with a human-like consciousness.

Despite the narrow focus of conversational AI, it is a lucrative boon for enterprises, bringing in more profits and delivering highly effective customer support. Yes, the most common use case might be an AI chatbot, but there are plenty of other enterprise use cases, including:

- 1. Accessibility:** Organizations can use AI to reduce entry barriers for users who need assistive technologies. Language translation and text-to-speech dictation are commonly used features within this category.
- 2. HR:** Onboarding, employee training, and maintenance of employee information can all be optimized by conversational AI. Leave requests, performance reviews, and compliance tasks can also be automated.
- 3. Health Care:** Conversational AI can improve the administrative, operational efficiency of claims processing, appointment booking, and patient information retrieval. Furthermore, patients can use conversational AI to check symptoms and get key information on their prescription drugs.
- 4. Internet of Things Devices:** Most households have 1 or more IoT devices, including smartphones, smart TVs, virtual home assistants, and more. These devices can use speech recognition in interactions with users and fulfill tasks – they can even go further and integrate with features of the house, like controlling the lights or adjusting the thermostat.

## Business Solutions and Use Cases

### Use Case: **Virtual Website Assistant**

One of Intetics' clients, a mid-sized service provider, requested the design and development of a virtual website assistant with AI capabilities. The client recognized that the integration of this intelligent element on their website would set them apart from competitors.

First, the development team collaborated with the client's PR and marketing teams; they collaborated to set up these focal areas, among others:

#### Design

- Create a dialog window that fits the site's style without obstructing content.
- Design and animate a "character".
- Engage with linguists to develop a professional, unique, and friendly conversation style.

#### Content

- Customize what data can be presented to customers through the virtual assistant.

#### Dialog Settings

- Collect industry-specific jargon to create natural-sounding dialog.
- Make dialog highly adjustable, and train the Client's team on how to customize it.
- Include pre-built NLP to make basic dialogs.
- Augment it with RASA to generate extended answers.
- Include analytics for further improvements.



This use case was highly successful; the virtual assistant didn't just provide site users with effective support; it was also an incredibly effective marketing tool that increased session times. With the virtual website assistant, lead engagement rose by 35%. What's more, the sales team gained an additional source of information about leads before the initial contact.

## Use Case: Healthcare

Many people do not like to visit doctors or are even afraid of them. But they also need a doctor's opinion about diseases and health problems, as well as their respective treatments.

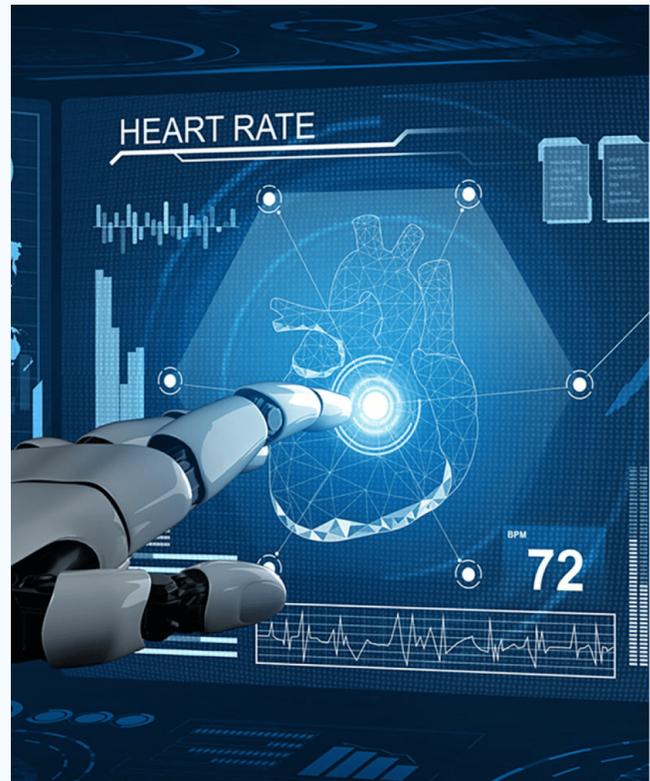
Of course, people can find out information via the Internet, but it's better to use a competent Virtual Assistant. Could you even imagine how easy it would be to get reliable health advice with this technology? With a Virtual Assistant, people will be able to live a healthier lifestyle and improve their overall well-being.

### Design

- At first, the user must sign in and input their age, weight, and gender.
- Then, the user must select the category for which they want to consult and/or get advice. For instance: a healthy diet, problems with sleep, or headaches.
- Then, the assistant can give some pieces of advice and recommend a doctor to contact.

### Content

- A system that will be able to keep people healthy and even prevent serious troubles and diseases.
- Users can ask any question of interest and get an answer from a professional point of view.



### Benefits

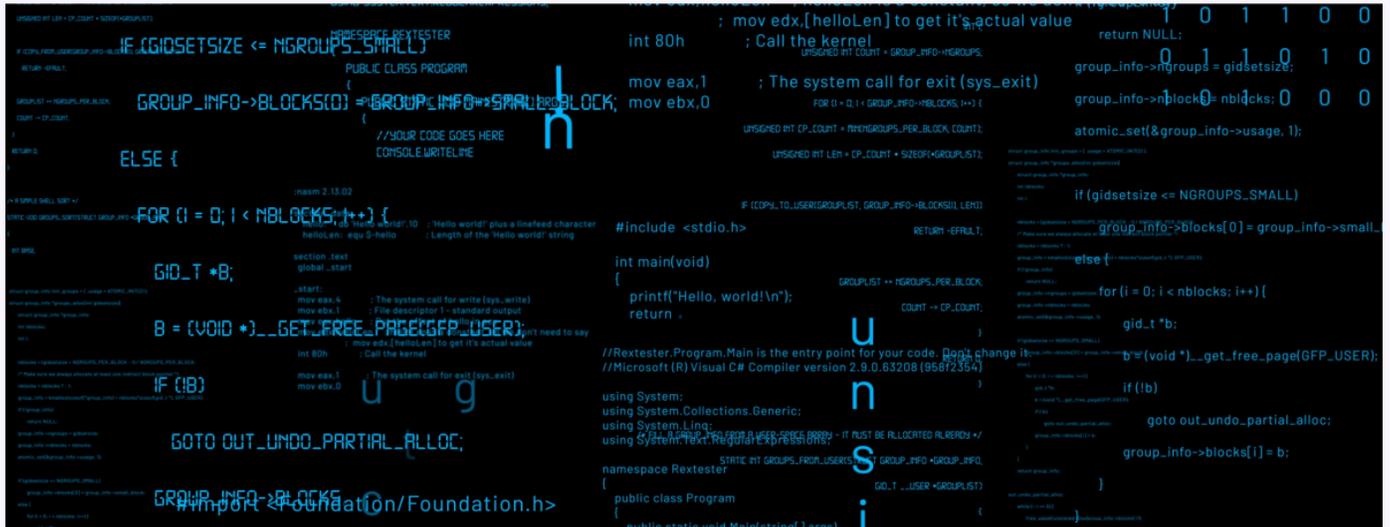
- ★ Professional opinion at any time
- ★ A way to constantly maintain your health
- ★ Early identification of problems

### Conclusion

As a result, we created an Assistant that encourages people to devote more time to taking care of themselves and their health. Also, the assistant is able to instill good habits, for example: drink enough water, do not forget about physical activity, eat right, undergo a regular medical examination, and consult with doctors if necessary.

## Use Case: Computer Software

A Virtual Assistant can be used to simplify the work of a software developer. For instance: with the assistant, the developer will be able to make a decision about the type of application as well as decide on the programming language and project concept. Also, the assistant will answer any common questions that might appear.



### Design

- To begin with, the developer must understand their type of project: will it be a site or application? If it's an application, then is it for a desktop or portable device? With this information, the assistant can deliver tailored recommendations.
- Also, the user has to detect what language and core features will be used for the project.

### Content

- A system that will help the developer create the project that best meets the client's expectations.
- The user will be able to consult with the assistant and ask any questions.

### Benefits

★ Permanent consultancy about the project

★ A source of information that helps in creating projects

### Conclusion

In conclusion, we have an assistant to help with the creation of a project, which can continuously guide the user and lead to a well-informed decision.

## Use Case: Internet of Things Devices

Nowadays, we can't do without such devices as smartwatches, smart scales, smartphones, etc. It's a part of our reality; these items are essential to our routine, work, study, and relaxation. IoT devices bring us so many benefits and make our lives easier.

The most trivial example is when your smartphone or the smartwatch on your wrist reminds you of something. For instance, it might inform you that you've received a message or that it's time for you to move.

A virtual assistant is another example of an IoT-enabled gadget that's a part of our daily lives.



### Design

- The virtual assistant can make communication with your gadgets easier. For instance, you can set reminders, find information on the internet, and more.
- Also, it helps you live according to your personal schedule, as you can plan your life via gadgets.

### Content

- The assistant makes your communication with devices easier and more comfortable – and, by extension, it adds efficiency and value to your lifestyle

### Benefits

- ★ Constant help in following your personal schedule, as well as planning, improving, and expanding the functions of routine devices

### Conclusion

As a result, we can get the maximum use out of our gadgets; we can also expand and improve these functions.

## Use Case: Online Customer Support

Online customer support is a crucial part of our communication with online services and apps. We may have lots of questions, but many companies don't have customer service representatives that are available around the clock. In such cases, a virtual customer support assistant is highly useful.



### Design

- You may ask any questions you want. Perhaps you don't understand some functions or features of the service or app. The virtual assistant can help you find a solution.
- The assistant will help you and explain everything in the most understandable and accessible way.

### Content

- A virtual assistant that offers continuous help with the usage of internet services and apps.

### Benefits

- ★ Around-the-clock help, thus improving customer loyalty and reducing staffing expenses

### Conclusion

In conclusion, we've got an assistant that simplifies issues and helps the user quickly understand and deal with the features of various programs and services.

## Standards in Use

For society to fully embrace conversational bots, they must be designed in a way that fosters trust – and this set of guidelines from Microsoft outlines best practices for Conversational AI design.

- **Before beginning the bot's design phase, determine whether it will support consequential use cases;** i.e., does the bot provide access to education, employment, healthcare, financing, or another service that has a significant impact on the user. If so, determine if the bot's intended purpose can work without oversight from the operator or whether it inherently needs human judgment.
- **Develop metrics for the assessment of user satisfaction.** Collect feedback on the user's sense of comfort and well-being during the bot interaction, as well as whether they feel that the bot has accomplished its intended purpose.
- **Be transparent about your usage of a bot.** Bots are more likely to be trusted when their intentions and limitations are made clear. Set reasonable expectations, and perhaps a link for users who want to "learn more" about the bot's purpose, operation, and potential errors.
- **Ensure a seamless transition from bot to human-based interactions.** If interactions may need human judgment, provide a clear way for the user to get access to a human moderator.
- **Guide against misuse.** When appropriate, provide notice to the user about code of conduct breaches - for instance, if they write threats, bullying content, or hate speech. For further prevention of misuse, deploy a 2-way filtering mechanism with a customizable tolerance threshold, so your bot can detect and respond appropriately to offensive user input.
- **Ensure the reliability of your bot.** This can be done by building traceability capabilities in your bot, providing a feedback mechanism, and, in sensitive use-cases, consult with experts in the industry.
- **Respect user privacy.** Inform users upfront about how data is collected and used; provide easy access to your company's privacy statement and service agreement. Collect only the essential personal data, store it for no longer than necessary, and limit access to it.
- **Make it accessible.** Consider how your bot complies with international web accessibility standards like WCAG.2.0.AA. Have people with disabilities test out your bot, and make sure your bot is designed for compatibility with the full range of human abilities.

## Industry Associations, Magazines, Social Media Groups

### The Chatbot

[The Chatbot.](#) This online magazine provides thoughtful, comprehensive, and entertaining content about AI and NLP technologies. Verticals include HR, IT, Healthcare, Education, Gaming, eCommerce, Customer Service, and more.

### D!igitalist Magazine

[Digitalist Magazine.](#) This web magazine offers a robust Machine Learning/AI section, but it also covers topics like Blockchain, IoT, and the Digital Economy.

### MARTECHSERIES MARKETING TECHNOLOGY INSIGHTS

[MarTechSeries.](#) Stay updated with the latest marketing news - including interviews, expert insight, and whitepapers related to conversational AI and other marketing applications.



[SAP Community.](#) Learn about how to build chatbots through tutorials suitable for beginners, intermediate, and advanced users. There are also community blog posts, webinars, and "coffee corner" discussions.

### TOPBOTS

[TOPBOTS.](#) Offers educational resources on AI and machine learning; they have a Facebook group, a Twitter page, a weekly newsletter, and plenty of published research on their website.

## Top Contributors to the Conversational Platforms Market

Gartner Peer Insights has compiled a list of the top Conversational Platforms – these platforms can be used to build chatbots, virtual assistants, and conversational user interfaces. Such conversational solutions can be integrated into social media, messaging platforms, web chats, and SMS. They have strong NLP engines, supporting text and voice input modalities, and the capability for dialogue management, training data maintenance, and multiple chatbot orchestration.

Some of the top contributors to the Conversational Platforms Market are:



### Amazon AWS

Its Conversational AI platform, [Accenture](#), offers a suite of assets for organizations to manage the end-to-end lifecycle of their conversational AI solution. AWS/Accenture's solutions reduce wait times, ease call volume surges, and use machine learning to facilitate continuous improvement.



### Google

Its comprehensive platform, [Dialogflow](#), supports voicebots and chatbots. Currently, over 1.5 million developers build conversational AI chatbots with Dialogflow. With this solution, virtual agents offer supplemental questions for multi-turn conversations. And with the prebuilt agents and visual builder, the development stage can take just a few hours.



### IBM

IBM's [Cognitive Care](#) solutions use AI technology, intelligent automation, and real-time data to help companies create smarter omnichannel experiences. In IBM's highlighted use cases, Bradesco experienced a 95% accuracy rate with their AI assistant's responses to customer queries. And, with Generali, in the first year of their AP chatbot's deployment, they saved \$1 million. Caixabank managed to condense 60+ service phone numbers to just one number with their streamlined omnichannel AI support.

## Available Certifications for Practitioners



### Rulai Institute



Rulai offers free, comprehensive AI courses that come with 1-on-1 guidance and hands-on practice.

Options:

- » Conversational AI Designer Certification Course  
(40 hours of instruction)
- » Conversational AI Developer Certification Course  
(30 hours of instruction)

### Microsoft AI School



If you are interested in bite-sized learning sessions that can be completed in about 30 minutes, Microsoft AI School has plenty of free topics.

Options:

- » Create Bots With Azure Bot Service
- » Building Bots With REST
- » Create Interactive Conversational Bots for Microsoft Teams

## Healthcheck for Your Business

Conversational AI is not the perfect solution for every company – so before you begin development, we recommend working through a "healthcheck" to ensure that it is, indeed, the right choice for you. A few considerations include:



### **Does such a solution make sense with your current web presence?**

In order to harness the full potential of conversational AI, you need to have a website or mobile app with many users and lots of functionality; the latter is especially important, as users need to have something to ask about. If your company focuses more on the physical storefront and doesn't have a large web presence, adding conversational AI isn't going to suddenly draw in site visitors. Instead, think about whether you should invest more into the development and promotion of your website.



### **Are there enough tasks that can be fulfilled without human interaction?**

One main goal of conversational AI is to automate some tasks so that humans have more time – yet, if your chatbot calls a human operator to supplement almost every conversation, it is likely not worth the investment.



### **Is your digital ecosystem large enough?**

Conversational AI brings more value if it's integrated in an omnichannel environment, such as a website, mobile application, social network profile, and even a phone line in combination. If you're only going to use it in one place, the investment might never pay off.



### **Will a quicker response time make a difference?**

Chatbots are always available to give prompt answers to specific questions, collect basic customer info, and pre-qualify leads. If your customers typically have time-sensitive yet simple queries, a chatbot as the first contact could be an ideal solution.

## Resources and Readings to Dive Deeper Into Conversational AI Technology

If you would like to gain a deeper understanding of conversational AI technology and its applications, these resources provide a wealth of information.



### [Council Chatbots ROI Analysis and Market Summary](#)

A summary of key findings related to U.K. council chatbots, including Planning, Waste and Recycling, Revenues and Benefits, and Highways.

### [Designing Bots: Creating Conversational Experiences](#)

Provides practical bot-building design patterns and real-world examples. Learn the steps for building Slack and Facebook Messenger bots.

### [Chatbots: The Definitive Guide](#)

A free, 14 chapter guide on chatbots, including an eBook download. Get an overview of limitations, benefits, case studies, statistics, chatbots during COVID-19, and the future of conversational AI.

# Statistics on Conversational AI

## 1. Consumers listed these main advantages of chatbots:

- 24/7 service (64%)
- Immediate answers (55%)
- Answers to basic questions (55%)

(Drift, 2018)

## 2. 52% of consumers find that voice assistants are more practical than using an app or a website.

(Conversational Commerce by Capgemini Report – 2018)

## 3. Companies that use conversational AI have experienced increased customer satisfaction.

(LivePerson, 2019)

## 4. The departments that will benefit the most from conversational AI are:

- Customer Service
- Sales/Marketing
- Order Processing

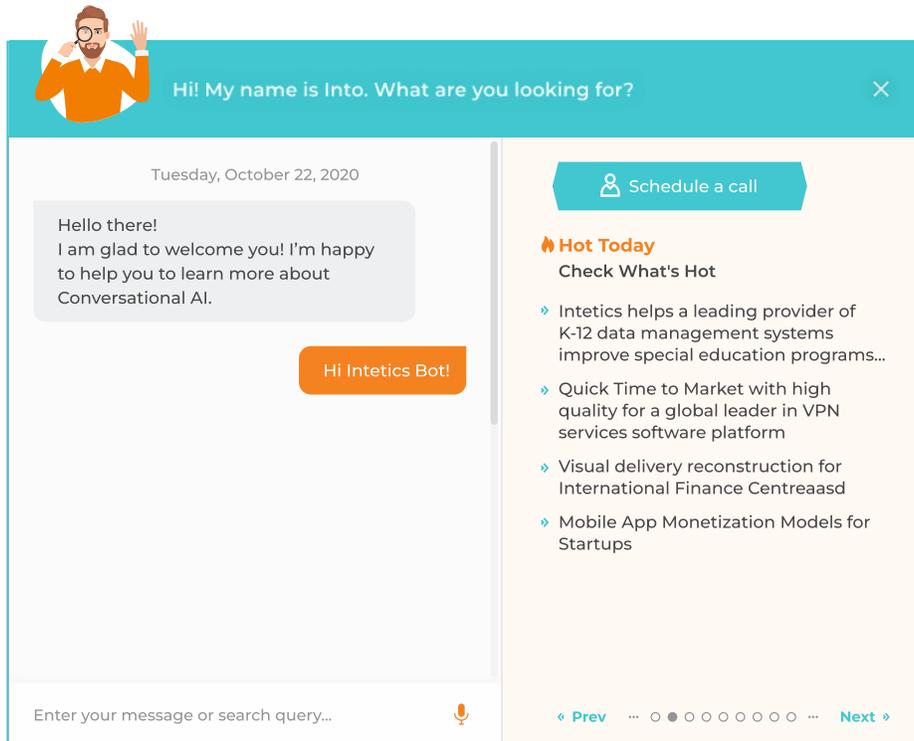
(Mindbrowser, 2017)

## Summary and Conclusions

It's clear that chatbots and virtual assistants have become prevalent over the last few years. These intelligent systems are more capable than ever due to their deep learning algorithms. With how quickly technology is evolving, such applications of conversational AI will improve steadily, and the market will keep soaring.

Consumers are now familiar – and even comfortable – with conversational AI interactions. As AI assistants become the new norm, consumers are developing clear expectations of what issues bots should address and at what point issues should be routed to living staff. When conversational AI is used appropriately and meets these expectations, there is tremendous potential to improve the customer experience.

Organizations that don't take a customer-centric approach when deploying conversational AI are missing out on the chance to develop deep, valuable relationships with consumers. In order for an organization to successfully harness the power of AI, it must understand the current climate towards virtual assistants and, accordingly, deliver a balance of human/bot assistance.



# Conversational AI for Business Success: Peer Reviewed Strategy to Build Profitable AI Model [Paper Presentation at ISDIA 2024]

According to [Deloitte's report on Conversational AI](#), 50% of customers would immediately proceed with a Conversational AI chatbot, while 90% would use CAI when waiting. Unhappy customers cost businesses USD 537 trillion yearly, while business inefficiency losses remain uncalculated.



Conversational AI is a highly [lucrative technology for enterprises](#), helping businesses prevent customer attrition, enhance experience, and become more profitable.

While AI-powered chatbots and virtual assistants are the most popular forms of conversational AI, many other use cases exist across industries.

Discover business applications, benefits, and strategies for implementing Conversational AI within an organization, peer-reviewed by the global academic community.

## Conversational AI for Business Success: How to Amplify Artificial Intelligence

On January 4, Pavlo Yalovol, Intetics VP of Innovation, presented the scientific paper **'Conversational AI for Business Success: How to Amplify Artificial Intelligence'** written by Boris Kontsevoi, Intetics CEO and President, at the virtual stage of the eighth edition of International Conference on Information System Design and Intelligent Applications (ISDIA).

**Read also:** [AI-Powered Coding Assistants—Friend or Foe for Developers? Pavlo Yalovol, Intetics Vice President of Innovation for ITID Lviv](#)

The ISDIA 2024 conference brought together researchers, scientists, engineers, students, and industry practitioners to exchange theories, methodologies, new ideas, experiences, products, and applications in all areas of intelligent computing methodologies. Participants explored how [AI, ML, and other innovative technologies](#) enhance and safeguard our interconnected world.

Get a glimpse of the key presentation insights, and feel free to [access the full paper](#) by reaching out.

## AI in Action: Advancements, Capabilities, and Transformative Benefits

Conversational AI and virtual voice assistants with natural language processing (NLP) and machine learning under the hood have emerged to simplify daily routines by handling tedious, time-consuming, or complex tasks. NLP deciphers human language, while ML enables learning from data, making these technologies proficient in human-like interactions.

The adoption of AI experienced a [10% surge](#) from 2021 to 2023, attributed to the proactive efforts of IT professionals. Projections [indicate](#) a substantial annual increase of 38% in the global AI market value from 2022 to 2030.

Recent research by McKinsey [highlights](#) the financial advantages of incorporating conversational AI, positioning companies with a competitive edge, and driving heightened investments in [AI development](#).

## Conversational AI's Potential across Industries

AI-driven chatbots and virtual assistants enable seamless conversations, automate mundane tasks, and gather valuable customer insights across Healthcare, Finance, E-commerce, Education, and other industries:

### Healthcare

- **Medical R&D:** AI accelerates the development of new treatments by analyzing large datasets to identify trends.
- **Data Analysis:** Optimizes healthcare by processing patient histories and diagnostic information.
- **Diagnosis and Treatment:** AI assists in diagnosing and treating patients from symptom descriptions.
- **Patient Engagement:** Virtual assistants facilitate appointment bookings and health record management.

### Finance

- **Risk Management:** AI evaluates risks through extensive data analysis and pattern recognition.
- **Fraud Detection:** Detects fraud by analyzing data volumes and spotting anomalies in real-time.
- **Personalized Service:** AI virtual assistants offer customized advice based on customer data.

### E-commerce

- **Lead Generation:** Engages customers and gathers information for sales teams.
- **Personalized Recommendations:** Enhances shopping experience by analyzing purchase history.
- **Payment Processing:** Improves checkout experience and can increase conversion rates.
- **Customer Service:** AI assists with queries and provides information.

### Education

- **Virtual Helpers:** Supports students with scheduling and administrative tasks.
- **Automated Grading:** Saves time for educators and enables personalized student support.
- **Smart Tutoring:** Adapts to student learning speeds and provides targeted explanations.
- **Early Warning System:** Identifies academic issues early, enabling timely intervention.

**Featured Case Study:** [AI-Powered Virtual Nurse Helps Over 100,000 Patients Worldwide to Monitor Their Health Daily](#)

## Advancements in NLP: Models & Algorithms

Recurrent neural networks for generating word sequences enable tasks like text prediction, handwriting recognition, and speech recognition. Explore the newer NLP models, which can answer intricate research questions and process information across multiple languages.

### Advancements in NLP: Models & Algorithms

**1. Pretrained Language Model**

- Streamlines medical R&D, data analysis, and patient care.
- Powers diagnosis, treatment, and patient engagement tools.

**2. Adversarial NLP**

- Enhances model robustness against attacks and input alterations.
- Improves model resilience in real-world applications like spam and fake news detection.

**3. Transfer-Learning Model**

- Adapts knowledge from one task to improve performance in similar tasks.
- Accelerates NLP training for specific applications.

**4. Cross-Lingual Models**

- Trains models in one language, then fine-tunes in others for text classification.
- Adjusts the final layer for new language nuances.

**5. Dialogue Systems**

- Fine-tunes conversational AI for domain-specific interactions.
- Generates human-like responses for diverse conversation scenarios.

**6. Multi-Modal Models**

- Processes multiple types of input data simultaneously.
- Combines information for advanced user experiences.

**7. Algorithms Within NLP Models**

- Utilizes various decoding techniques for output generation.
- Employs reinforcement learning for effective dialogue interactions.

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## Different Types of NLP Models

There are four key neural network architectures:

- Feedforward Neural Networks (FNNs):** Process data unidirectionally from input to output. Suited for tasks without sequential/temporal dependencies. Applied in classification and regression.
- Convolutional Neural Networks (CNNs):** Ideal for grid-structured data like images. Use convolutional layers to detect patterns. CNNs are used in image recognition and object detection.
- Generative Adversarial Networks (GANs):** Composed of a generator and discriminator network. The generator creates data; the discriminator differentiates from accurate data. GANs are employed in image generation and data augmentation.
- Recurrent Neural Networks (RNNs):** Designed for sequential data processing. Feedback loops allow the learning of patterns in sequences. RNNs are applied in language processing and time series analysis. Challenges like vanishing gradients are addressed by LSTM and GRU variants.

## The Ethical and Reliability Challenges of AI

Discover core challenges faced by conversational AI that businesses should be aware of:

- **Understanding Context:** AI may struggle with broad contexts and subtle nuances, leading to misinterpretations.
- **Data Bias Risks:** Reliance on incomplete or biased training data can lead to skewed and unfair interaction outcomes.
- **Human Oversight Necessity:** Expert review is essential to mitigate risks of unexpected consequences from AI autonomy.
- **Vulnerabilities to Exploitation:** AI systems can be exploited for disinformation and propaganda.
- **Consumer Trust:** McKinsey survey [reveals](#) high consumer trust in AI, often surpassing human expertise.
- **Realism and Validation:** AI should not be the sole decision-making tool; rigorous human testing and validation are crucial.

## NLP API Options: A Look into Leading Choices

There are various APIs (Application Programming Interfaces), which encompass a range of functionalities, including sentiment analysis, entity recognition, text categorization, language detection, text generation, and more.

Therefore, when selecting an API, several key factors should be taken into consideration: customization and control, complexity of use case, platform compatibility, and integration ease. Some of the prominent NLP APIs are OpenAI GPT, Google Cloud Natural Language API, Google Dialogflow, Amazon Comprehend & Lex, IBM Watson NLU & Assistant, Microsoft Azure Cognitive Services, Wit.ai, spaCy, Algorithmia, and others.

## Key Steps to Developing a Successful Conversational AI Business Model

Formulating a successful conversational AI business model implies these crucial steps:

- **Defining the niche:** Identify a specific domain where conversational AI solutions can provide value. The niche should align with the expertise of the business and cater to a genuine market need.
- **Creating a high-quality product:** The product must possess natural communication, complex query understanding, accurate responses, and scalability.
- **Leveraging NLP tools:** Integrating NLP enhances the AI's ability to engage with users intuitively.
- **Integration with existing systems:** Seamless integration with established business systems (CRM, ERP, help desk software, etc.) bolsters the AI's capabilities and elevates the overall customer experience.
- **Developing a go-to-market strategy:** This strategy should encompass the following elements: target audience definition, needs and preferences analysis, and marketing plan.
- **Monitoring and optimization:** Utilize analytics tools to glean insights from customer inquiries and employ these insights to drive continuous improvements that enhance system performance.

# Key Steps to Transform Conversational AI into a Profitable Venture

01

## Defining the Niche

1. Identify a specific domain for AI application.
2. Align with business expertise and market needs.

02

## Creating a High-Quality Product

1. Ensure natural communication and complex query understanding.
2. Focus on accuracy and scalability.

03

## Leveraging NLP Tools

1. Integrate tools for intuitive user engagement.

04

## Integration with Existing Systems

1. Seamlessly connect with CRM, ERP, help desk software.
2. Enhance AI capabilities and customer experience.

05

## Developing a Go-to-Market Strategy

1. Define target audience and analyze needs.
2. Create a comprehensive marketing plan.

06

## Monitoring and Optimization

1. Use analytics for customer interaction insights.
2. Continuously improve system performance.

**Additional Note:** Staying informed about trends and technologies is crucial in this dynamic field.

Conversational AI can enhance lives when used appropriately and aligned with user expectations. Here are a few examples and numbers:

- **Business Process Optimization:** Up to 25% cost reduction and 30% productivity growth with record management, task management, auto-scheduling, email filtering, and fast onboarding and training powered by CAI.
- **Enhanced Decision-Making:** Up to 95% of information accuracy thanks to easy report generation, advanced analytics, and smart recommendations.
- **Advanced Customer Interactions:** Customer satisfaction increases by up to 50% with service/product recommendations, intelligent comparison, and a robust sales funnel.

Successful implementation demands meticulous planning, experimentation, and continuous monitoring to achieve desired outcomes.

Are you considering starting to plan and implement conversational AI technologies for your niche? [Get started](#) with advanced approaches and industry solutions now.

## More about Conversational AI Business Applications:

- [Conversational AI. The New Era of Human-like Automated Communication](#)
- [AI Transforming Healthcare Solutions with Conversational Intelligence in Medical Virtual Assistants](#)
- [Chatbot Center of Excellence: Chatbots Turnkey Development](#)

# Short Guide to Creation of Your Enterprise Knowledge Assistant (EKA)

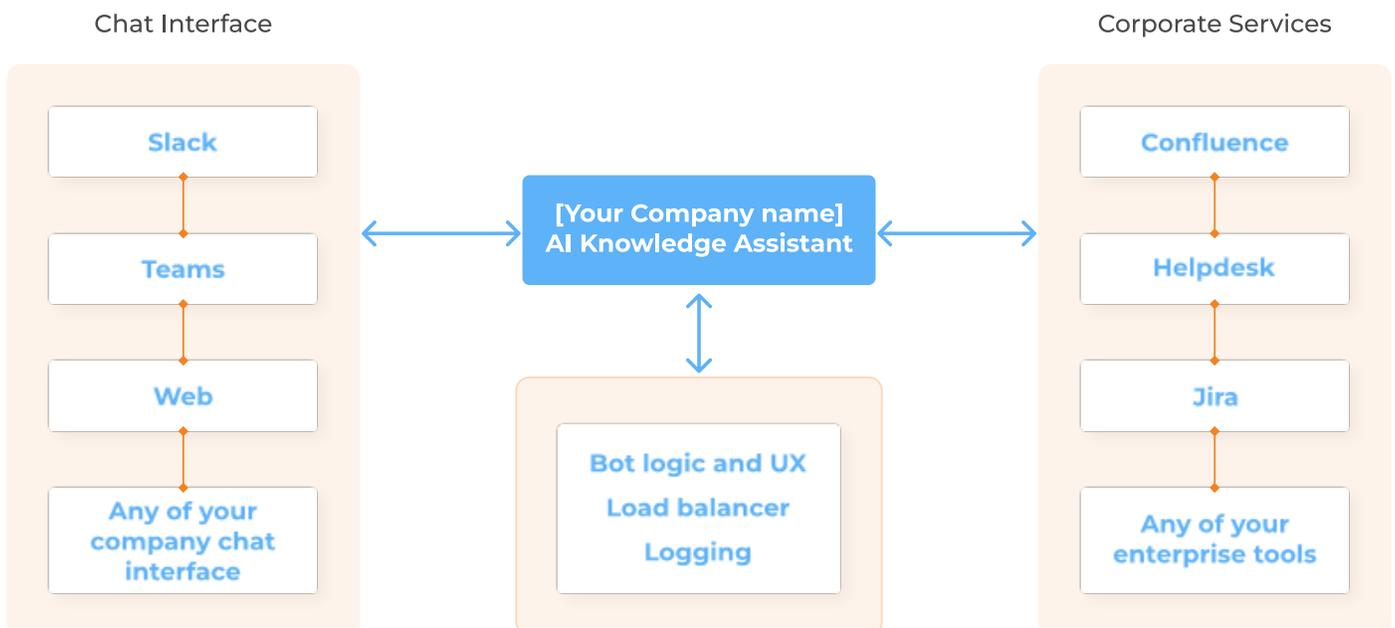
EKA is an advanced AI-driven solution that utilizes **Gen AI, NLP, and ML** to automate and speed up information retrieval, customer support, and task management within organizations **by 30-50%**.

## EKA Capabilities

- Digital Content Production:**  
*Generate/Create/Edit*  
 Create job descriptions, draft PTO requests, and outline software requirements tailored to your company's needs—no unnecessary fluff.
- Knowledge Hub: Question Answering/ Customer Support/ HelpDesk**  
 Answer internal user questions with the expertise of a 30-year veteran employee. Ensure high-quality outputs and a productivity boost through custom GenAI training based on your corporate knowledge base.
- Sentiment Analysis:**  
*Evaluate/Detect/Interpret*  
 Analyze unstructured communications to gain actionable insights, identify priorities, issues, churn risks, and retraining needs.
- Data Hub:**  
*Extract/Summarize/Classify*  
 Extract structured data from unstructured texts, summarize large bodies of text and other media, and classify data efficiently from your company knowledge systems, like Confluence or SharePoint.

## How It Works

Knowledge Assistant is seamlessly integrated with platforms like Slack and Microsoft Teams, available through a simple chat interface. Just send a message, and EKA seamlessly understands the context, selects the right tool, and retrieves information or takes action immediately on your behalf.



## Key Features and Benefits

- ★ **Customizable AI**  
Get a personalized common Large Language Model (LLM) with your unique corporate data.
- ★ **Increased Productivity**  
EKA can reduce the time employees spend searching for information **by up to 50%**, and speed up key business decisions **by 20-40%**.
- ★ **Cost Savings**  
**Automating 40%** of routine inquiries and cutting training time **by 30-50%** can significantly reduce the need for additional staff or overtime.
- ★ **Improved Customer Service**  
Faster, accurate responses can boost NPS and CSAT scores **by 10-20%** and improve first-contact resolution **by 20-30%**.
- ★ **Extensive Integration**  
Unlimited integrations, enhancing functionality across all business operations.
- ★ **Operational Efficiency**  
Automating tasks can improve process throughput **by 20-40%** and reduce human error rates **by 50-70%**.
- ★ **Enhanced Knowledge Management**  
Better utilization and retention of knowledge assets can improve **by 30-50%**, reducing redundancy and knowledge loss.
- ★ **Compliance and Risk Management**  
Automated compliance handling can reduce fines **by up to 50%** and **lower operational risks by 20-30%**.

## EKA Implementation Steps

Phase	Tasks	Duration (weeks)
<b>MVP/Pilot Development – 3 weeks</b>		
MVP/Pilot Development	Defining objectives and developing a high-level proposal outlining EKA system's architecture	1
	A basic prototype of EKA system	1
	Initial testing and validation of chosen LLM approach	1
<b>Implementation – 29+ weeks</b>		
1. Assessment & Planning	<ul style="list-style-type: none"> <li>Defining EKA system objectives and scope</li> <li>Developing a detailed architecture proposal</li> </ul>	3
2. Design & Setup	<ul style="list-style-type: none"> <li>Designing EKA system architecture and data integration methods</li> <li>Servers, databases, and networking components setup</li> </ul>	6
3. Data Integration & Migration	<ul style="list-style-type: none"> <li>Data mapping, cleaning and integration</li> </ul>	5
4. LLM Integration	<ul style="list-style-type: none"> <li>LLM Integration (Third-Party)</li> <li>LLM Hosting and Fine-Tuning (Own)</li> </ul>	6
5. Connect EKA to Client's systems	<ul style="list-style-type: none"> <li>Setting up a chat interface</li> <li>Integrating EKA with one or more systems</li> </ul>	2 (per system)
6. Testing and Validation	<ul style="list-style-type: none"> <li>System Testing</li> <li>User Acceptance Testing (UAT)</li> </ul>	4
7. Training & Deployment	<ul style="list-style-type: none"> <li>Training &amp; Deployment</li> </ul>	3
8. Post-Deployment Support & Maintenance	<ul style="list-style-type: none"> <li>Support and Monitoring</li> </ul>	0

**Book a consultation today to leverage all the benefits of AI in EKA solution tailored to your specific needs!**

Chapter 2

# Generative AI for Software Organizations (#GenAI)

# Why GitHub Copilot Is the Ultimate Game-Changer for Software Developers

Since entering the programming scene, GitHub Copilot has sparked discussions about whether it's a giant leap toward the end of traditional coding or just a really good autocomplete tool.

With the [rise of AI](#), Copilot has gotten even better.



Let's break it down and see why it's a handy tool for programmers to speed up the coding process, learn new frameworks or libraries, or explore different ways of solving problems.

## What Is GitHub Copilot?

GitHub Copilot is an AI pair programmer providing auto-complete style recommendations as you code. It accelerates your coding process by analyzing contextual elements like variable names, surrounding code, and function signatures, generating relevant suggestions in real time.

The concept of an "AI pair programmer" underscores its collaborative nature, emphasizing that it complements and augments your coding efforts—it cannot work without you.

GitHub Copilot is powered by a generative AI model developed by GitHub, OpenAI, and Microsoft.

Once installed, the coding assistant analyzes the developer's code, providing suggestions for completing code snippets, suggesting relevant functions, and even refactoring existing code.

**Read also:** [ChatGPT for Software Developers: Better Code, Increased Productivity, and Premier Product Quality \[With Examples of Prompts\]](#)

## Installing GitHub Copilot: Step-by-Step Guide

GitHub Copilot integrates with various popular integrated development environments (IDEs), such as Visual Studio Code, Visual Studio, Neovim, and JetBrains IDEs.

GitHub Copilot can be accessed through personal accounts with GitHub Copilot Individual or organizational accounts with GitHub Copilot Business. GitHub Copilot is free for verified students, teachers, and maintainers of popular open-source projects.

You can try GitHub Copilot for free with a one-time 30-day trial. After the free trial, you will need a paid subscription for continued use. Billing plans are [available at GitHub Docs](#).

To get started, you'll need the following:

- An active GitHub Copilot subscription

- Microsoft Visual Studio Code (or another preferred IDE)
- The GitHub Copilot extension installed in the Visual Studio Code

### How to Install GitHub Copilot?

- Find the GitHub Copilot extension page in the Visual Studio Code Marketplace and click Install.
- Click Open Visual Studio Code in the pop-up window that appeared.
- Click Install in the "Extension: GitHub Copilot" tab in Visual Studio Code.
  - ✓ If you have not previously authorized Visual Studio Code in your GitHub account, you will be prompted to sign into GitHub in Visual Studio Code.
  - ✓ If you have previously authorized Visual Studio Code for your account on GitHub, GitHub Copilot will be automatically authorized.
- If you don't get the prompt to authorize, click the bell icon in the bottom panel of the Visual Studio Code window.
- In your browser, GitHub will request the necessary permissions for GitHub Copilot. To approve these permissions, click Authorize Visual Studio Code.
- To confirm the authentication, in Visual Studio Code, in the "Visual Studio Code" dialog box, click Open.

GitHub Copilot can be customized to align with your coding style. Configure settings like indentation, line length limits, and suggestion verbosity to make Copilot an extension of your coding preferences.

## Creation of UI Elements with Prompts in GitHub Copilot

GitHub Copilot's capability to generate code suggestions extends to creating user interface (UI) elements. By providing clear and concise prompts, developers can elicit relevant code snippets for various UI components, such as buttons, dropdown menus, and text fields.

**Example:** We need to create a tracker of monthly income and expenses.

Let's generate a prompt for GitHub Copilot:

```
<!--bootstrap grid with 12 rows and 1 column for small screens, and 6 rows and 2 columns for medium screens and above, each cell contains label of the month from January to December, and 2 bootstrap number inputs side by side with labels, 1 for income and 1 for expenses -->
```

Based on the input, GitHub Copilot starts to suggest the code to generate the desired output.

To accept the suggested code, just press Tab, and the assistant will write the code.



GitHub Copilot proves to be a valuable tool for frontend developers to elicit relevant code snippets for various UI components efficiently. The example illustrates the importance of reviewing Copilot's suggestions by an experienced developer to ensure correctness and code optimization.

While Copilot accelerates the code-writing process, user intervention remains essential for ensuring logic, accuracy, and adherence to specific requirements. Let's focus on how to engineer prompts that guarantee Copilot's efficient assistance.

## Getting Desired Outcomes with Prompts: Best Practices

Once we have reviewed the capabilities to generate entire functions, classes, or blocks of code faster, let's touch on the best practices for prompt engineering to give clear instructions to GitHub Copilot and generate desired results.

- **High-level context in comments:** Provide high-level context in a comment at the top of the file and leave more detailed instructions in the form of comments and code.
- **Provide specific details:** For precise code suggestions from GitHub Copilot, provide specific details. If you aim, for example, to fetch data from an API, specify the type of data, processing method, and the target API endpoint.
- **Provide examples:** Apart from instructing GitHub Copilot verbally, you can also demonstrate desired actions using examples in your preferred coding style.
- **Iterate and refine:** Continuously refine your code with Copilot's suggestions. Start with its recommendations and customize them to meet your specific requirements. Regularly review and adjust the generated code to match your coding style and project needs.
- **Validate generated code:** Validate Copilot-generated code for correctness, efficiency, and adherence to standards. Conduct thorough code reviews, run comprehensive tests, and make necessary adjustments to maintain codebase quality.

In turn, GitHub is experimenting with LLMs to evolve Copilot, focusing on creating a developer-friendly AI experience that is predictable, tolerable, steerable, and verifiable to enhance overall productivity and effectiveness. All this is done to extend GitHub Copilot across the developer lifecycle.

## Other Ways to Enhance Your Coding Workflow with GitHub Copilot

Explore additional capabilities of GitHub Copilot to refine your coding process:

- **Code refactoring:** GitHub Copilot aids in refactoring by suggesting concise and efficient alternatives, identifying redundancies, simplifying complexity, and recommending improved coding patterns for cleaner, more maintainable code.
- **Error & exception handling:** Copilot assists in error handling by suggesting mechanisms and blocks for exceptions, enhancing code robustness and resilience to unexpected scenarios.
- **Customization:** Enhance GitHub Copilot by customizing its training with your codebases, allowing it to generate more accurate, context-aware suggestions tailored to your specific application domain.
- **Consistency across teams:** GitHub Copilot is valuable for team development, aiding in maintaining coding standards by suggesting consistent styles and practices. Its suggestions are discussion starters in code reviews, fostering collaboration, and knowledge sharing among team members.

## Summing Up

It still requires profound expertise to build software. Even with Copilot's help, a developer should verify and understand generated code. Non-programmers can't jump on Copilot and make whatever they want. Or is it so yet?

Keep a keen eye on the dynamic [AI assistant's landscape](#)—experiment with emerging options in your environment to identify the ones that align best with your requirements. Explore tools like GitHub Copilot, and stay tuned to learn more about alternatives: [Bito](#), [Amazon CodeWhisperer](#), [Tabnine](#), etc.

[Join us](#) to empower developers to be more productive at every stage of the [software development lifecycle](#).

# Alternatives to GitHub Copilot: Tabnine, AWS CodeWhisperer, and Bito to Increase Developers' Productivity by 20%

[GitHub Copilot](#) was developed collaboratively by GitHub and OpenAI and utilizes OpenAI's Codex, a transformer trained on vast amounts of code from GitHub repositories. This tool automatically creates code snippets, functions, tests, and documentation by analyzing existing code and your cursor position. It leverages the shared knowledge of the coding community for an incredibly insightful coding experience.



But! Copilot may not be a one-size-fits-all solution. Different developers have different preferences, workflows, and needs. Recognizing this diversity, let's explore alternative tools that offer similar code completion features (and more).

## Quick Intro to Useful Alternative Plugins to GitHub Copilot

We'll delve into three notable alternatives of GitHub Copilot: Tabnine, AWS Codewhisperer, and Bito.

Before diving into the distinctive features of each tool, here's a quick look at what each one brings to the table:

	Tabnine	AWS Codewhisperer	Bito
<b>Trained on</b>	Open-source code	Amazon and open-source code	Open-source text and code
<b>Self-hosting</b>	Possible	Not possible	Not possible
<b>Personalized AI model</b>	Yes	No	Yes
<b>Special features</b>	Generate unit tests, Translate code, Offline access Complete code	Fix code, Detect code smells, Reference tracking Complete code	Code navigation, Summarize recent code changes, AI chat
<b>Free plan</b>	Yes	Yes	Yes
<b>Price for paid plans</b>	\$12/user/month or customized pricing for Enterprise	\$19/user/month	\$15/user/month
<b>Free trial</b>	14 days	No	No

*AI-based plugins comparison: Tabnine, AWS Codewhisperer, Bito*

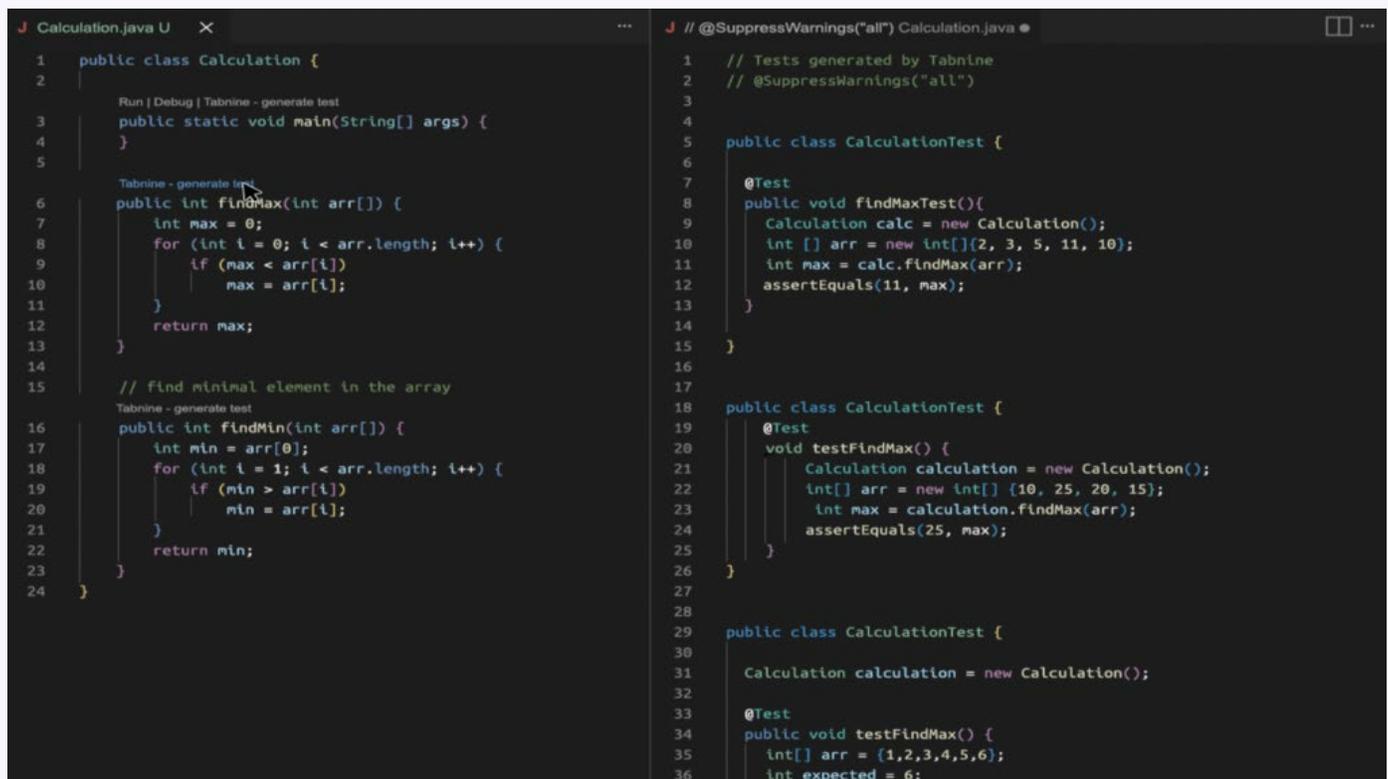
## Tabnine

Tabnine was an early player in terms of code completion tools, and it provides a practical plugin compatible with your preferred code editor. It offers suggestions for whole lines of code and full-function completions across various languages, libraries, and frameworks. And it does so based on natural-language comments.

One noteworthy aspect of Tabnine is its efficiency with minimal context compared to [Copilot](#). It suggests code midline as you type, without waiting for one line to be finished before moving to the next.

For teams and organizations, Tabnine offers the capability to host and train their own [AI models](#). This feature facilitates collaborative autocompletion across IDEs, which enhances teamwork and contributes to code security.

Beyond code completion, Tabnine tackles unit test support. Using advanced AI, it automatically generates unit tests for your code, a helpful feature for ensuring thorough testing and code stability, especially on larger projects.



The screenshot displays two side-by-side IDE windows. The left window shows the source code for a Java class named `Calculation`. It includes methods `main`, `findMax`, and `findMin`. A mouse cursor is positioned over the `findMax` method, and a tooltip indicates the option to "Tabnine - generate test". The right window shows the generated unit tests for the `Calculation` class, including `CalculationTest` with `@Test` annotations and assertions.

```
1 public class Calculation {
2
3     Run | Debug | Tabnine - generate test
4     public static void main(String[] args) {
5     }
6
7     Tabnine - generate test
8     public int findMax(int arr[]) {
9         int max = 0;
10        for (int i = 0; i < arr.length; i++) {
11            if (max < arr[i])
12                max = arr[i];
13        }
14        return max;
15    }
16
17    // find minimal element in the array
18    Tabnine - generate test
19    public int findMin(int arr[]) {
20        int min = arr[0];
21        for (int i = 1; i < arr.length; i++) {
22            if (min > arr[i])
23                min = arr[i];
24        }
25        return min;
26    }
27 }
28
29 // Tests generated by Tabnine
30 // @SuppressWarnings("all")
31
32 public class CalculationTest {
33
34     @Test
35     public void findMaxTest(){
36         Calculation calc = new Calculation();
37         int [] arr = new int[]{2, 3, 5, 11, 10};
38         int max = calc.findMax(arr);
39         assertEquals(11, max);
40     }
41 }
42
43 public class CalculationTest {
44     @Test
45     void testFindMax() {
46         Calculation calculation = new Calculation();
47         int[] arr = new int[] {10, 25, 20, 15};
48         int max = calculation.findMax(arr);
49         assertEquals(25, max);
50     }
51 }
52
53 public class CalculationTest {
54     Calculation calculation = new Calculation();
55
56     @Test
57     public void testFindMax() {
58         int[] arr = {1,2,3,4,5,6};
59         int expected = 6;
60     }
61 }
```

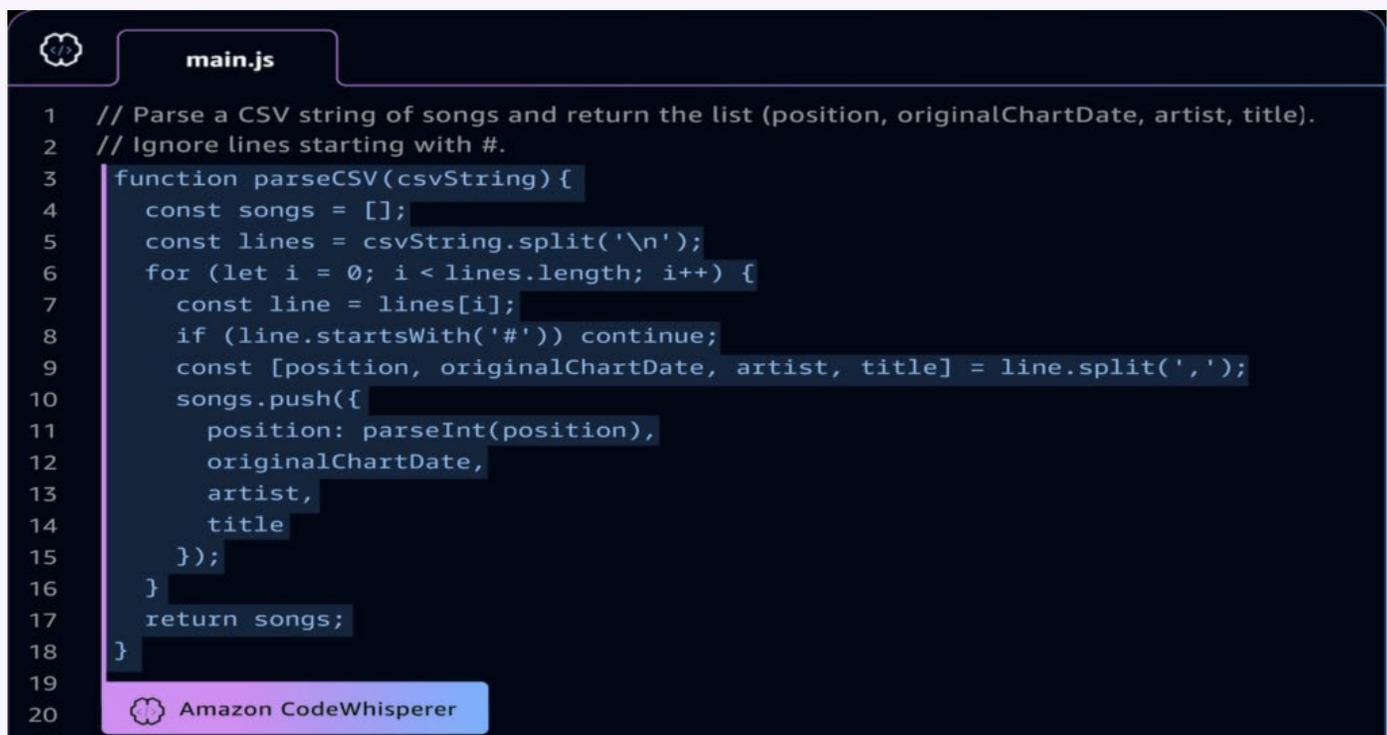
The interface is user-friendly, requiring minimal configuration. As you use it more, Tabnine adapts and tailors unit test suggestions to your coding style.

## AWS CodeWhisperer

Amazon CodeWhisperer understands natural language comments in English and offers suggestions ranging from snippets to entire functions—up to 10–15 lines—in various IDEs. Similar to Tabnine, CodeWhisperer adapts to your coding style and ensures a personalized coding experience. It also extends its capabilities to the command line with inline documentation and AI-driven natural-language-to-code translation.

For those leveraging AWS services, CodeWhisperer analyzes code in real time, with suggestions tailored to AWS APIs like Amazon EC2 and AWS Lambda and aligned with best practices for cloud-based projects.

To ensure responsible coding, the tool introduces a reference tracker for open-source code. This feature flags suggestions resembling public code with detailed annotations for review. The goal here is to actively avoid biases in code suggestions.



```
1 // Parse a CSV string of songs and return the list (position, originalChartDate, artist, title).
2 // Ignore lines starting with #.
3 function parseCSV(csvString) {
4     const songs = [];
5     const lines = csvString.split('\n');
6     for (let i = 0; i < lines.length; i++) {
7         const line = lines[i];
8         if (line.startsWith('#')) continue;
9         const [position, originalChartDate, artist, title] = line.split(',');
10        songs.push({
11            position: parseInt(position),
12            originalChartDate,
13            artist,
14            title
15        });
16    }
17    return songs;
18 }
19
20 Amazon CodeWhisperer
```

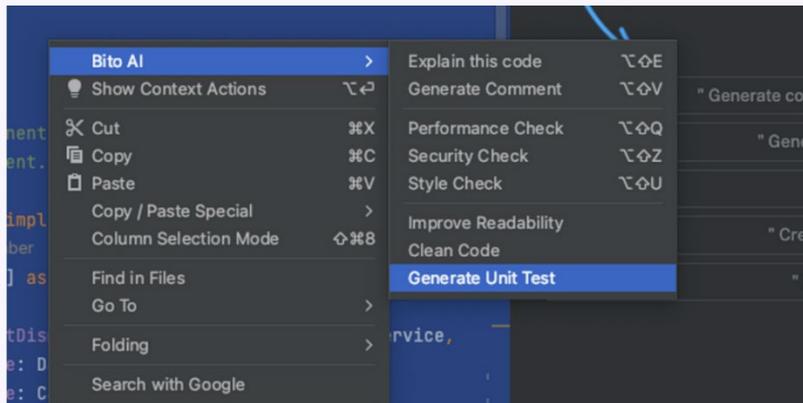
If you're choosing between AWS CodeWhisperer and Tabnine, consider what you prioritize. Let's say you value versatility and broad language support across various editors; then Tabnine is your pick. CodeWhisperer, on the other hand, is for those who focus on precision — the tool learns from in-house code and tailors suggestions to an organization's practices.

## Bito

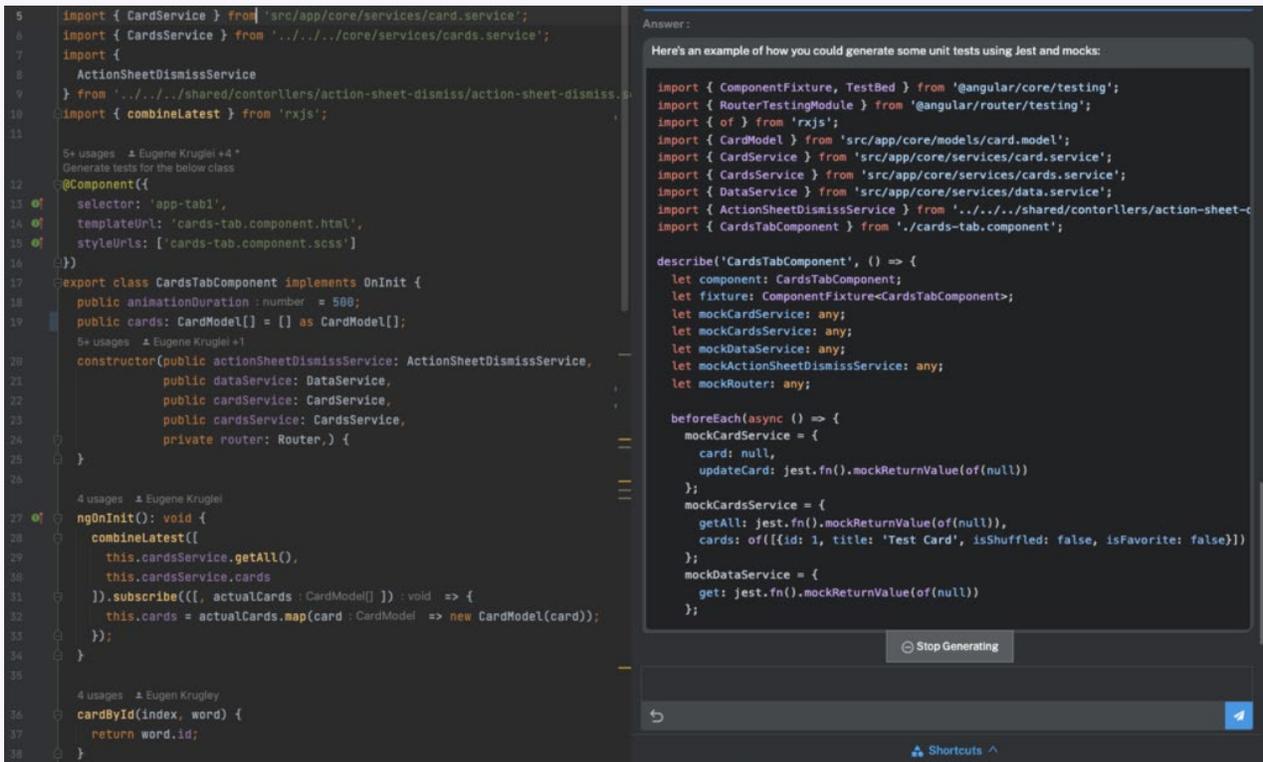
Bito allows users to generate code in any language, create comprehensive test cases, and gain insights into selected code snippets with the Explain Code feature. For documentation, Bito offers a Comment Method tool, while the Improve Performance feature provides tips for enhancing code efficiency. Security concerns are addressed through the Check Security function, which lets you inquire about potential issues.

What sets Bito apart from GitHub Copilot is its integration with Visual Studio Code — it leverages embeddings and a vector database to understand your local codebase. This ensures context-aware suggestions, a distinctive advantage over Copilot.

Another noteworthy feature is the Generate Unit Test Shortcut:



The shortcut allows developers to efficiently generate test cases for different code paths and scenarios. This ensures comprehensive testing coverage and reduces the risk of undetected bugs.



The consistent testing standards promoted by Bito foster collaboration and codebase maintainability within development teams, as all members can adhere to the same testing practices.

## On Ethics for AI Code Completion Plugins in Software Development

Respecting intellectual property rights and privacy is [crucial for ethical software development](#), fostering trust in the industry.

Developers using code completion tools like Tabnine, Bito, etc. should:

- ensure that sensitive or confidential data is not intentionally or unintentionally exposed;
- be mindful not to breach non-disclosure agreements (NDAs);
- seek explicit consent from clients or stakeholders before employing coding assistant tools in projects involving their codebases.

On the level of software development organizations, it's a best practice to regulate AI tools usage in processes. Many [responsible engineering companies](#) already create and implement AI tools usage policies for employees on how to be safe and secure when using generative AI, especially when it involves the sharing of potentially sensitive company and customer information.

### Summing Up

The implementation of AI assistants like Tabnine, AWS CodeWhisperer, and Bito has resulted in tangible time savings and enhanced productivity. And we have the numbers to back this up.

In just two weeks, **Tabnine** contributed to a nearly **13-hour timesaving** for an Intetics engineer. That month, 27% of that engineer's code was produced by the tool.

With **AWS CodeWhisperer**, the official figures claim **a 57% acceleration in developer productivity and a 27% increase in the likelihood of project success**.

As for **Bito**, the subjective experience reveals improvements in speed, particularly in implementing new features. The initial estimate suggested a potential 27% code contribution, but real-world results prove a more conservative **productivity boost of 10-20%**. Also, Bito offers remarkable efficiency, potentially **saving up to 80% of time spent on writing unit tests**.

To wrap it up, embrace the tools that empower you to code better and faster.

#### Featured materials:

- [ChatGPT for Software Developers: Better Code, Increased Productivity, and Premier Product Quality \[With Examples of Prompts\]](#)
- [Why GitHub Copilot Is the Ultimate Game-Changer for Software Developers](#)
- [AI-Augmented Project Management: 15 Ways to Automate Time-Consuming Tasks with ChatGPT \[+12 Other AI Assistants\]](#)

# ChatGPT for Software Developers: Better Code, Increased Productivity, and Premier Product Quality [With Examples of Prompts]

While debates persist in media and professional communities regarding the advantages and drawbacks of generative AI in software development, engineers seeking innovation and efficiency are already actively integrating it into daily work.



The emergence of ChatGPT, a powerful and widely available large language model (LLM), has stirred the quest for perfection in code and product quality.

Find out the most valuable use case of ChatGPT for software developers and a list of use cases that align with NDA with prompts and outputs examples.

## Table Of Content:

1. ChatGPT Use Cases Classification Based on Type of Communication
2. ChatGPT Common Use Cases for Software Developers
  - Writing Unit-Tests Example
  - Writing Regular Expressions
  - Create Source Code Snippet by NL Description: from Simple to Complex
  - Create Boilerplate Code by NL
  - Naming
  - Search Information: Patterns, Libs, Existing Solution
  - Discussing How to Solve the Problem
3. ChatGPT Plugins for Software Development
  - Web Developer Plugin
  - Check Website Down Plugin
  - Cloud Diagram Generation Plugin
  - SEO CORE AI Plugin
  - ChatGPT Code Interpreter
4. NDA Issue—Can One Share Source Code with ChatGPT?
5. Summary

**Read also:** [AI-Powered Coding Assistants—Friend or Foe for Developers?](#)

## ChatGPT Use Cases Classification Based on Type of Communication

From the programming point of view, interaction with ChatGPT can be split into two categories:

1. entering code into ChatGPT—Programming Language (PL)
2. asking questions in a common way—Natural Language (NL)

Such distinction provides a more structured and transparent approach to utilizing the model's capabilities.

Prompt context	Answer	Use Case
PL	PL	Bug fixing
	NL	Provide source code and ask to explain it
NL	PL	Naming—create name by purpose of var, class, or function
		Boilerplate code
		Code snippets
		Pattern implementation
	NL	Search information—patterns, libs, existing solution
		Discuss something—how to solve the problem
PL+NL	PL	Performance optimization
		Change request implementation
	NL	Provide source code, define context in NL, and ask to explain it

*ChatGPT use cases classification table*

Now, having a more organized understanding of common ChatGPT use case types, let's delve specifically into real examples of prompts to streamline programming in various scenarios.

## ChatGPT Common Use Cases for Software Developers

Utilizing the practical experiences shared by our engineers, we've made a list of typical use cases where ChatGPT accelerates the completion of coding tasks.

Whether it's regular expressions, unit tests, code snippet writing, or seeking the most optimal solution, ChatGPT effortlessly handles diverse aspects of software engineering.

### Writing Unit-Tests Example

Chat GPT can help in writing unit tests for JavaScript / Typescript applications, simplifying the process and ensuring quality code.

**Prompt:** Write down Karma unit-tests for the given Angular Directive + **\*\*Directive Code\*\***

```
ts Copy code  
  
import { CopyToClipboardDirective } from './copy-to-clipboard.directive';  
import { ComponentFixture, TestBed } from '@angular/core/testing';  
import { Component, DebugElement } from '@angular/core';  
import { By } from '@angular/platform-browser';  
  
@Component({  
  template: '<button efcCopyToClipboard="Hello, world!" (click)="onClick($e)'  
})  
class TestHostComponent {}  
  
describe('CopyToClipboardDirective', () => {  
  let fixture: ComponentFixture<TestHostComponent>;  
  let buttonDebugElement: DebugElement;  
  let copySpy: jasmine.Spy;  
  
  beforeEach(() => {  
    TestBed.configureTestingModule({  
      declarations: [CopyToClipboardDirective, TestHostComponent]  
    });  
  
    fixture = TestBed.createComponent(TestHostComponent);  
    buttonDebugElement = fixture.debugElement.query(By.css('button'));  
  
    copySpy = spyOn(navigator.clipboard, 'writeText');  
    copySpy.and.callThrough();  
  
    fixture.detectChanges();  
  });  
  
  it('should create an instance', () => {  
    const directive = new CopyToClipboardDirective();  
    expect(directive).toBeTruthy();  
  });  
  
  it('should call clipboard', () => {
```

Result

## Writing Regular Expressions

**Prompt:** Write a typescript angular method to replace variables enclosed in `<$...$>` with their corresponding values from the passed `vars` object. If a value for a particular variable is not found in `vars`, the variable in the source string is not replaced. Make the syntax as compact as possible using all the features of TS.



Sure, I can provide you with a method that will replace variables enclosed in `<$...$>` with their corresponding values from the passed `vars` object.

Here it is:

```
typescript Copy code  
  
replaceVars(source: string, vars: {[key: string]: any}): string {  
  return source.replace(/<\$\s*(\w+)\s*\$/g, (match, key) => vars[key] ?? match)  
}
```

In this TypeScript method, we are using a regular expression (`/<\$\s*(\w+)\s*\$/g`) to search for patterns in the source string that match the format of the variables enclosed in `<$...$>`.

Then, we use the `replace()` function which uses a callback function as its second parameter. This callback function takes the full match and the captured group (which is the key within the variable markup) as parameters.

The function body `(match, key) => vars[key] ?? match` will try to access the `vars` object with the key, and if the key doesn't exist (i.e., `undefined`), it will fallback to the original matched string.

The `??` is a nullish coalescing operator in TypeScript (and JavaScript) which returns the right-hand side operand if the left-hand side operand is `null` or `undefined`, otherwise it returns the left-hand side operand.

Result

## Create Source Code Snippet by NL Description: from Simple to Complex

**Prompt 1:** What is in C# date time format for this sample Jan 24, 2023, 15:56.

```
DateTime time = DateTime.ParseExact("Jan 24, 2023 15:56",  
    "MMM dd, yyyy HH:mm", CultureInfo.InvariantCulture);  
  
string output = time.ToString("MMM dd, yyyy HH:mm",  
    CultureInfo.InvariantCulture);
```

*Result*

**Prompt 2:** Write C# code to delete files and folder from location list.

```
using System;  
using System.IO;  
using System.Collections.Generic;  
class Program  
{  
    static void Main(string[] args)  
    {  
        List<string> locationsToDelete = new List<string>  
        {  
            @"C:\Temp\file.txt", @"C:\Temp\folder", @"D:\Documents\file.docx"  
        };  
        foreach (string location in locationsToDelete)  
        {  
            if (File.Exists(location)) {  
                File.Delete(location);  
                Console.WriteLine("Deleted file: " + location);  
            }  
            else if (Directory.Exists(location)) {  
                Directory.Delete(location, true);  
                Console.WriteLine("Deleted directory: " + location);  
            }  
            else {  
                Console.WriteLine("Location does not exist: " + location);  
            }  
        }  
        Console.WriteLine("Done!"); Console.ReadKey();  
    }  
}
```

*Result*

## Create Boilerplate Code by NL

**Prompt:** I have class with two properties. Can I use it for data binding in ASP.Net controller.

```
public class MyModel
{
    public string Name { get; set; }
    public int Age { get; set; }
}

public ActionResult Index()
{
    var model = new MyModel
    {
        Name = "John Doe", Age = 30
    };
    ViewData["MyModel"] = model;
    return View();
}

@model MyModel
<div>
    <label>Name:</label>
    @Html.TextBoxFor(m => m.Name)
</div>
<div>
    <label>Age:</label>
    @Html.TextBoxFor(m => m.Age)
</div>
```

Result

## Naming

**Prompt:** How to name a service that defines surface and calculates its volume.

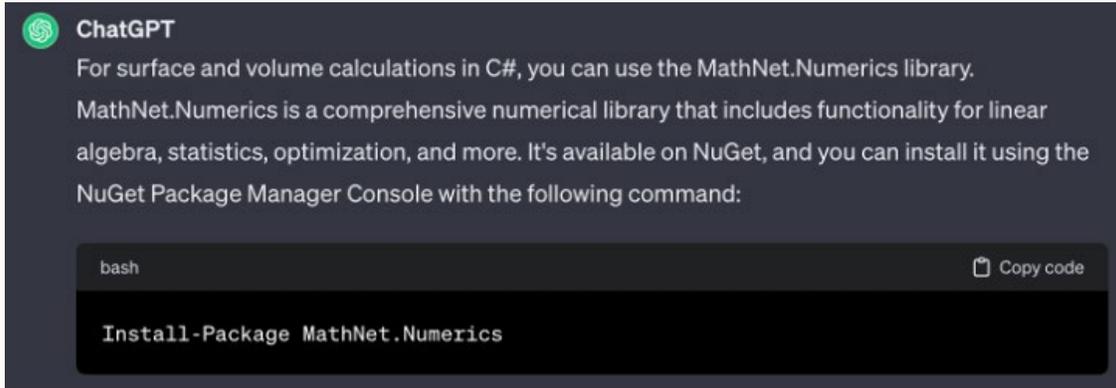
```
 ChatGPT
Naming a service that defines the surface and calculates the volume can be a creative and important step in branding. Here are some suggestions:

1. SurfVol Pro
2. SurfaceMate
3. VolumeCraft
4. GeoCompute
5. ShapeMaster
6. SurfaceGenius
```

Result

## Search Information: Patterns, Libs, Existing Solution

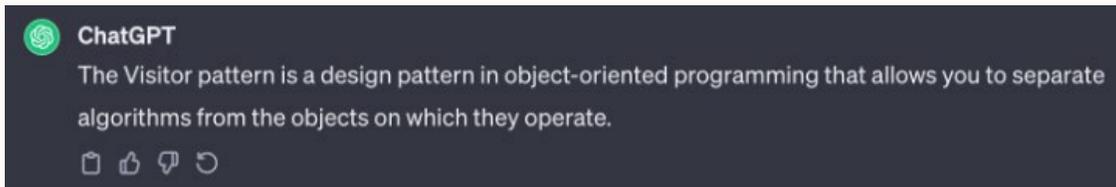
**Prompt 1:** I need to calculate surface volume. Is there any lib for this task. In C#.

A screenshot of a ChatGPT chat window. The header shows the ChatGPT logo and the name 'ChatGPT'. The main text reads: 'For surface and volume calculations in C#, you can use the MathNet.Numerics library. MathNet.Numerics is a comprehensive numerical library that includes functionality for linear algebra, statistics, optimization, and more. It's available on NuGet, and you can install it using the NuGet Package Manager Console with the following command:'. Below the text is a dark-themed code editor with a 'bash' prompt and the command 'Install-Package MathNet.Numerics'. A 'Copy code' button is visible in the top right of the code editor.

```
bash  
Install-Package MathNet.Numerics
```

*Result*

**Prompt 2:** What is a Visitor pattern?

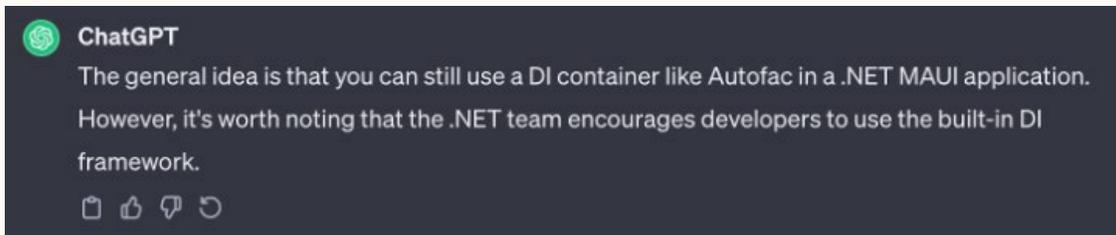
A screenshot of a ChatGPT chat window. The header shows the ChatGPT logo and the name 'ChatGPT'. The main text reads: 'The Visitor pattern is a design pattern in object-oriented programming that allows you to separate algorithms from the objects on which they operate.' Below the text are icons for copy, like, dislike, and refresh.

The Visitor pattern is a design pattern in object-oriented programming that allows you to separate algorithms from the objects on which they operate.

*Result*

## Discussing How to Solve the Problem

**Prompt:** I used Autofac as a DI in my Xamarin Forms application. I want to migrate to MAUI. Should I replace Autofac?

A screenshot of a ChatGPT chat window. The header shows the ChatGPT logo and the name 'ChatGPT'. The main text reads: 'The general idea is that you can still use a DI container like Autofac in a .NET MAUI application. However, it's worth noting that the .NET team encourages developers to use the built-in DI framework.' Below the text are icons for copy, like, dislike, and refresh.

The general idea is that you can still use a DI container like Autofac in a .NET MAUI application. However, it's worth noting that the .NET team encourages developers to use the built-in DI framework.

*Result*

As you can see, ChatGPT presents various opportunities for task automation, promising time savings and improved product quality. Yet, the real game-changer emerges when applying ChatGPT plugins specifically designed for software developers. Keep reading to discover the hands-on applications of ChatGPT Plugins that we've put to the test.

## ChatGPT Plugins for Software Development

To make the chatbot even smarter, you can install [plugins](#) in your ChatGPT. There are [dozens of different plugins](#) to choose from in the ChatGPT store. To assist you, we've experimented with the most popular plugins available and compiled a list of those we believe would be most beneficial for developers.

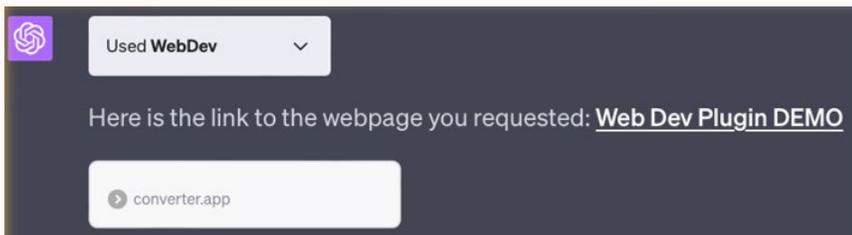
Keep in mind that you'll need to enable the plugin beta feature before accessing the store or these plugins.

### Web Developer Plugin



The Web Developer Plugin for ChatGPT enhances developers' workflow by providing instant code assistance, syntax checking, learning resources, and real-time debugging insights within their development environment. It streamlines web development, promotes best practices, and keeps developers informed about the latest technologies.

**Prompt:** Create simple HTML page with CSS and JS. H1 title = 'Web Dev Plugin Demo' p in the center of the page with count 2 buttons which increment and decrement count And give me the link

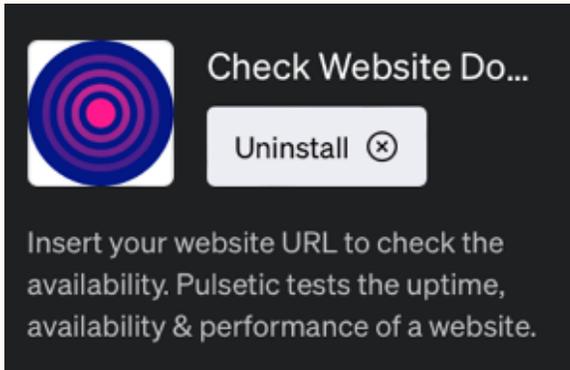


Result



The created page

## Check Website Down Plugin



The Check Website Down Plugin is valuable for software developers, offering quick and efficient monitoring of website status. It ensures prompt detection of downtime, enabling developers to swiftly address issues, minimize disruptions, and maintain optimal website performance.

**Prompt:** [https://example\\_website.com](https://example_website.com)

Location	Status	Response Time (s)	Response Code
New York	Up	0.08	200
Nuremberg	Up	0.08	200
London	Up	0.16	200
Los Angeles	Up	0.17	200
Johannesburg	Up	0.6	200
Toronto	Up	0.14	200
Tokyo	Up	0.22	200
Madrid	Up	0.18	200
Helsinki	Up	0.24	200
Ashburn	Up	0.06	200
Singapore	Up	1.94	200
Bangalore	Up	5.29	200
Sydney	Up	6.4	200

*Result*

## Cloud Diagram Generation Plugin



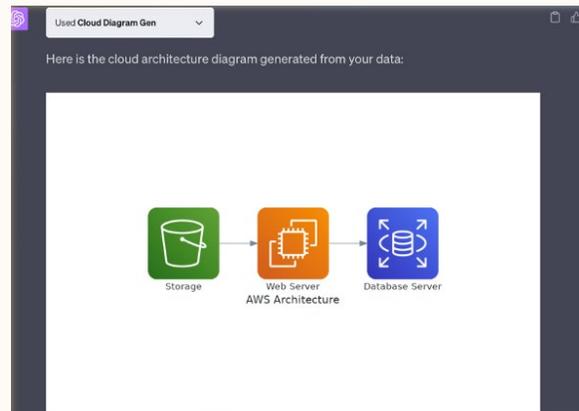
The Cloud Diagram Generation Plugin is valuable for software developers, offering efficient creation of visual representations for cloud architectures. It simplifies complex structures, aiding in clear communication, collaboration, and streamlined development of cloud-based applications.

With this plugin, you will be able to effortlessly create professional-looking diagrams that clearly show the relationships between your various systems and components.

**Prompt:**

```
FO Create diagram from this data
{
  "data": {
    "components": [
      {
        "id": "1",
        "type": "EC2",
        "name": "Web Server",
        "connections": ["2"]
      },
      {
        "id": "2",
        "type": "RDS",
        "name": "Database Server",
        "connections": []
      },
      {
        "id": "3",
        "type": "S3",
        "name": "Storage",
        "connections": ["1"]
      }
    ]
  }
}
```

**Result:**



**SEO CORE AI Plugin**



**SEO CORE AI**

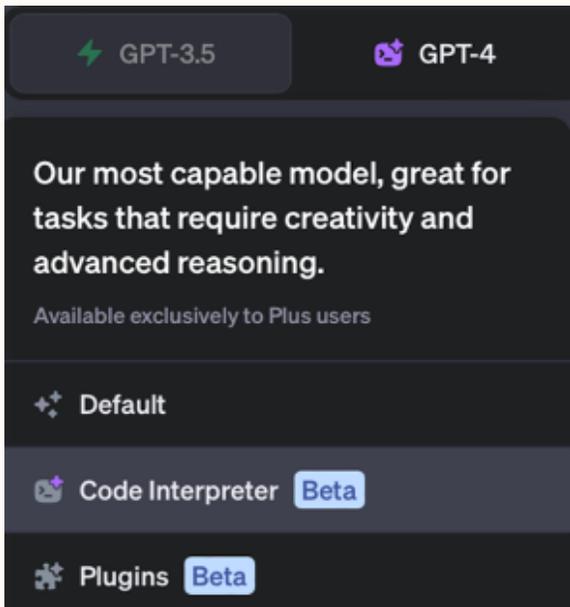
Use AI to analyze and improve the SEO of a website. Get advice on websites, keywords and competitors.

The SEO CORE AI Plugin is invaluable for software developers, providing advanced AI-driven insights to optimize website content for search engines. It enhances SEO strategies, boosts visibility, and streamlines the development of search engine-friendly applications.

**Prompt:** Give recommendations for improvements of [https://example\\_website.com](https://example_website.com)

As a result, ChatGPT will output a list of recommendations to improve SEO settings of a specific website page like title tag, meta description, h1 tag, content, URL, will suggest a number of backlinks with the required websites, etc.

## ChatGPT Code Interpreter

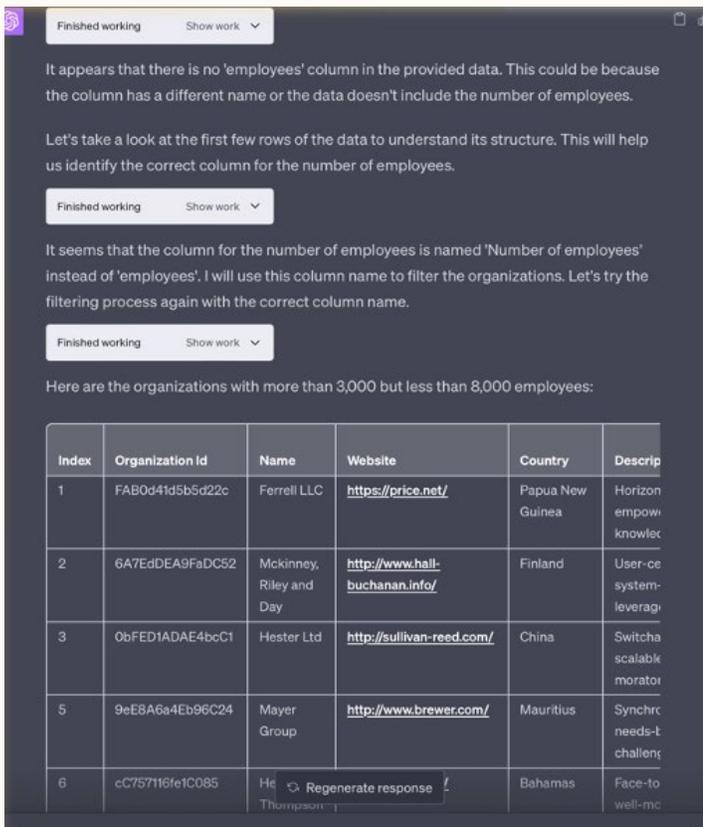
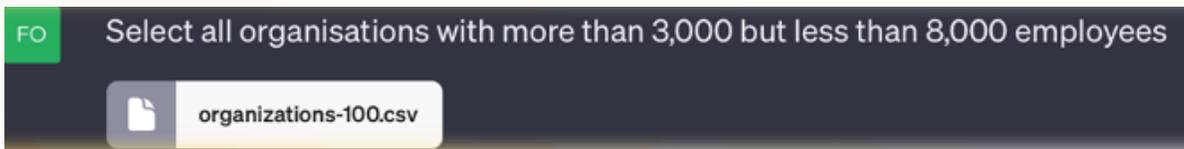


The ChatGPT Code Interpreter offers real-time code interpretation and execution assistance.

It accelerates debugging, aids in code comprehension, and enhances the overall development workflow.

Note: To access Code Interpreter's functionality, you need a ChatGPT plus account.

### Prompt:



### Result

ChatGPT plugins and ChatGPT Code Interpreter can save developers time across a variety of tasks even though this functionality is still in Beta, and their effectiveness is poised to improve over time.

And the final yet crucial question—how to navigate ChatGPT and its plugins' capabilities without breaching privacy policies and respecting NDA? Feeding source code and sensitive corporate data into the large language model may lead to massive leaks of proprietary information. How to address this challenge?

## NDA Issue—Can One Share Source Code with ChatGPT?

It's important to approach the use of ChatGPT for source code review with caution, especially when dealing with sensitive information covered by nondisclosure agreements (NDAs).

Certain use cases from the programming language (PL) and PL+NL classification rows could potentially breach NDAs. ChatGPT clearly states that all provided information can be reviewed by its engineers, and any sensitive information cannot be used in a prompt.

However, there are specific cases from the natural language (NL) classification row that may not pose a risk of NDA breaches:

Answer in PL:

- **Create source code snippet by NL description:** Generating code based on a natural language description can be a safe and helpful way to explore potential solutions without revealing proprietary details.
- **Create boilerplate code by NL requirements:** Similarly, generating boilerplate code based on natural language requirements can be a useful exercise without disclosing sensitive information.
- **Naming — "does my var or function name sound good?":** Seeking advice on variable and function names without providing the actual source code may not expose proprietary details.

Answer in NL:

- **Search information—patterns, libs, existing solution:** Using ChatGPT to search for general information, patterns, libraries, or existing solutions can be done without revealing specific proprietary code.
- **Discuss how to solve the specific problem:** Engaging in discussions about problem-solving strategies or high-level approaches, without divulging specific code details, can be a safe use of ChatGPT.

All in all, it's crucial to avoid sharing confidential source code or any proprietary information that could violate legal agreements.

## Summary

The most valuable application (without any risks of NDA violation) of ChatGPT for software developers is code snippet generation. It can generate boilerplate code based on "Stack overflow" in seconds, saving the developer's time.

To maximize effectiveness, engineers should:

- adhere to NDA principles
- clearly define tasks
- specify the context (programming language and framework)

- provide detailed information for iterative improvements
- utilize ChatGPT plugins and Code Interpreter
- and consider upgrading to ChatGPT Plus for uninterrupted server access and the latest features

\*\*\*

This is the first article in the publication series devoted to **AI-augmented software development**.

Stay tuned and explore further ChatGPT functionalities for managers and other AI assistants for software developers: GitHub Copilot, Tabnine, AWS Codewhisperer, and Bito. Reach out in case you have any questions or seek support.

# AI-Powered Coding Assistants—Friend or Foe for Developers?

Pavlo Yalovol, Intetics Vice President of Innovation for ITID Lviv

How does AI help software developers? What are the reliable AI-powered coding assistants besides the world-famous OpenAI's ChatGPT? How do those assistants affect efficiency and code quality? And what does Generative AI hold for the future of programming?



**Read also:** [ChatGPT for Software Developers](#)

[Pavlo Yalovol](#), Intetics Vice President of Innovation, delved into those questions in the recent publication titled "**AI-Powered Coding Assistants—Friend or Foe for Developers?**". The article is featured in the "Decade in Tech" issue of the ITID Lviv Journal.

In the article, you'll discover:

- Overview of the 10 specialized AI-driven development plugins;
- Examples of how AI assistants can be in the developer's work;
- How Intetics implements AI tools in software development projects;
- Impact of AI assistants on engineers' productivity: industry numbers vs. our engineer's assessment;
- The prospects of software development amidst advancing AI technologies.

"Nearly half of all developers use one or more AI-based assistants. The most popular in our company is GitHub Copilot, mainly due to the fact that a significant part of our code is stored on GitHub. ChatGPT is following closely in popularity.

To promote and use these tools, we've organized a series of webinars where our colleagues share their experiences using AI-powered plugins in programming."

*Pavlo Yalovol, VP of Innovation, Intetics*

You can access the full text by [the link \(pages 26-31\)](#).

**Spoiler:** we don't envision the future of [software development](#) without the use of AI assistants by programmers. Today, they have excellent capabilities and can significantly simplify the engineers' work.

Have you ever worked with AI-driven plugins for programming? Feel free to [share your insights](#) and experience with AI-powered coding assistants.

## About ITID Lviv

ITID Lviv is a quarterly print publication created to inspire and share achievements in the IT sphere. Since 2017, it has been issued by the Lviv IT Cluster, a community of IT companies in Ukraine, of which Intetics is an honored [member](#).

The magazine has a circulation of 3,000 copies distributed free of charge across Lviv's main facilities with an embarked mission to show the historical and touristic city from a different angle—a fast-growing tech hub in Ukraine and Eastern Europe.

**Read also:** [Ukrainian IT Sector: Prospering Against the Odds](#)

Chapter 3

# **AI in Healthcare**

(#Chatbots #Deeplearning)



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### Business Domain

Healthcare

### Project Type

Enterprise Platforms

# AI-Powered Virtual Nurse Helps Millions to Monitor Their Health Daily

## Client

The Client is a US-based unicorn startup developing a platform for creation of medical virtual assistants for healthcare establishments and insurance companies

## Project

Developing an empathy-driven conversational platform powered by world-class content, designed to enhance the patient experience, elevate brand preference, and encourage healthy behavior.

## Objective

To build a platform empowered with a virtual healthcare assistant to allow direct appointment scheduling, medication management, and Chronic Heart Failure (CHF) monitoring, as well as to promote patient engagement in healthcare and provide clinicians with monitoring tools to ensure patients stay healthy and receive timely treatment.

## Team Reinforcement

The Client looked for a trusted partner with relevant technical expertise and a solid portfolio of similar projects to quickly change the app's tech stack and develop new features. The task was delegated to Intetetics.

# Challenge

The Client partnered with a state-owned health organization to provide patients with on-demand access to its services and guided medical advice 24/7.

The Client aimed to have a cross-platform app with following features:

- Remote diagnostics of patients' health
- Device integration
- Speech recognition
- Text to speech

The app was to be localized into 30 languages, including Chinese and Arabic.

As the app constantly required improvements and the requirements were extended, the Intetics team took the initiative to integrate new features and provide all the required resources to design and implement the Client's idea.

## Quick Facts

- ✓ 8 years of collaboration
- ✓ 100,000 patients globally
- ✓ 30 languages covered

### Technologies

C++ / Java / .Net / PHP / Flutter / Angular / JavaScript / Node.js / AWS / MySQL / Terraform / Chef / Kubernetes / Jenkins / GitLab / Grafana

# Solution

## ★ 01

The Client constantly get positive customer's feedback and significantly increase the number of users.

## ★ 02

The clinicians can provide remote diagnostics, while accessing patient data through integrated EHR and Bluetooth device integration like blood pressure cuffs and scales.

## ★ 03

The virtual assistant is empowered with speech recognition through a proprietary classification engine and with text to speech to dynamically generate personalized lifelike responses.

## ★ 04

Successfully adopted the following technologies:

- AI
- Voice recognition
- Chatbots
- Integrations with modern medical devices

## ★ 05

8 years of continuous cooperation with Intetics.



## Benefits and Results

- ★ The app with new embedded features, like remote monitoring and a chatbot, allowed the Client to increase the number of users.
- ★ The created features with an admirable UX were highly appreciated by existing and new users, and the apps took top positions in application stores.
- ★ The Client has expanded to cover the needs of well-known healthcare players and providers.
- ★ The cooperation between the Client and Intetics lasted for 8 years.

### Techstack:

C++, Java, .Net, PHP, Flutter, Angular,  
JavaScript, Node.js, AWS, MySQL, Terraform,  
Chef, Kubernetes, Jenkins, GitLab, Grafana

### Team: 4

iOS developer,  
Android developer,  
Backend engineer,  
QA

# intetics

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## Business Domain

Healthcare and Life Sciences

## Project Type

Desktop application for surgeons

# Medical Device Company Received a New Application That Helps Surgeons Navigate Neural Implant Insertion

## Client

Established in 2000, BrainsGate is a medical device company committed to developing innovative therapies for patients suffering from Central Nervous System (CNS) diseases. BrainsGate's platform technology involves electrical stimulation of the Sphenopalatine Ganglion (SPG), a nervous center known to increase cerebral blood flow.

## Project

Development of a desktop application executed on special computers that assist a surgeon during an operation by inserting an implant into the patient's brain. The application helps in navigation.

## Objective

The Client required a new application that would navigate a surgeon in inserting an implant into the patient's brain. For this purpose, MRI images of a patient's head are processed by the software; ML&AI algorithms are used to build a path for an implant, which is shown on the screen on top of an MRI image.

## Team Reinforcement

BrainsGate doesn't have a software development team. The Client's team consists of doctors and scientists. Intetics' Remote In-Sourcing model was used to create a team of engineers that developed the application. The formed development team led the app development process while reporting to BrainsGate and the Client's Product Management

## Challenge

BrainsGate is exploring several applications for their technology and is currently focusing on the treatment of acute ischemic stroke. BrainsGate's technology is based on established scientific evidence that electrical stimulation of the Sphenopalatine Ganglion (SPG) increases cerebral blood flow.

The Client had many doubts about the technology selection. The application uses C++ for speed and control. On the other side, the application needed a friendly and functional user interface.

The Client doesn't have their own software developers and expected a vendor to provide a high level of service and develop the application that would be used during very sensitive surgery.

## Quick Facts

- ✓ FDA Approved solution
- ✓ Designed 100% of Client's application and implemented it
- ✓ The Client is able to concentrate on medical solutions, not technical details

### Technologies

C++ / ML&AI / Qt / Windows API / DirectX / OpenGL / Direct3D / DICOM / Multithreading / CT / MPR

## Solution

### ★ 01

The Client received the application, which helps surgeons save many lives and improve a patient's condition after an ischemic stroke.

### ★ 02

The created software fully emulates and presents to a surgeon in 3D view everything that is happening while inserting the implant.

### ★ 03

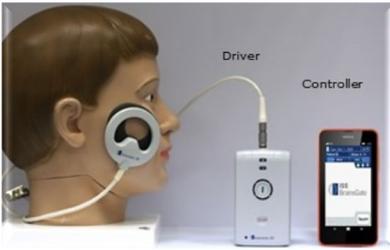
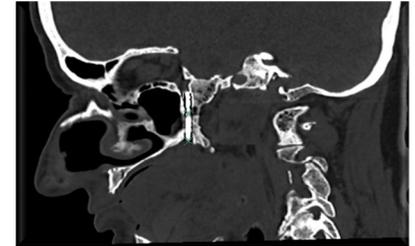
The software complex includes a special camera and pointers that help in navigation.

### ★ 04

The application is a part of the hardware and software complex that consists of a special camera, implant injector, optical markers, and CT marker. This is a very complicated solution that shows the patient's head and the position of the implant in real-time.

### ★ 05

The Remote In-Sourcing Team® was formed from high-level professionals that have specific knowledge not only in programming but also in the medical domain. The programmers were required to work with CT and MRI images along with their 3D models.



## Client Reference



*The Intetics team helped us with many directions, some of which we hadn't encountered before. Design, technology selection, implementation, and testing were made fully by Intetics.*

**Product owner**

## Benefits and Results

- ★ Only the unique knowledge of the Intetics team helped the Client build the solution with FDA-required parameters.
- ★ The newly created solution enables the Client to certify the whole hardware and software complex and start selling it in US clinics.
- ★ BrainsGate is currently running the ImpACT-24b, a multi-national, pivotal study to assess the safety and efficacy of its treatment for stroke patients in a 24-hour window.
- ★ The software solution was developed and implemented within 12 months of conception.

### Techstack:

C++, ML&AI, Qt, Windows API, DirectX, OpenGL, Direct3D, DICOM, Multithreading, CT, MPR

### Team: 7

Project Manager,  
System Analyst,  
Software Developers,  
QA Engineers,  
Designer

# intetetics

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## Business Domain

Startups

## Project Type

Mobile Application

# Mobile App for Babies' Diapers Scent Recognition with Recommendations for Child Care

## Client

NanoScent Ltd., an award-winning Israeli company, specializes in scent recognition with the help of hardware and ML. The Client's mission is to integrate smell-identifying and analyzing tools into everyday applications, spanning domains from Wellbeing to Industry 4.0.

## Project

The project's core idea involved developing a mobile application for managing a scent recognition device. The basic functionality included:

- parent registration,
- adding children's profiles to the app,
- keeping records about children's feeding and health.

## Objective

Develop a client-server cross-platform mobile app to recognize different statuses and parameters of babies' diapers and provide user recommendations based on machine learning algorithms.

## Team Reinforcement

NanoScent Ltd. sought a partner to form a team to meet all their needs and objectives. The collaboration between the Client and the Dedicated Team was very productive.

# Challenge

The Client needed to create a mobile application from scratch for iOS and Android platforms with an intuitive user interface. For this, they were looking for an experienced software provider of B2C applications with the most appealing UI and enterprise-grade mobile solutions that automate business processes.

The biggest challenge was to develop intuitive UX and UI. Each mobile application development project step was implemented following the recommendations of an experienced designer to ensure the best user experience.

Another challenge was related to the distinctive feature of the application—scent recognition of the diaper and its remote testing with the hardware.

## Quick Facts

- ✓ State-of-the-art technology approach to amplify innovation in the application
- ✓ A mobile application from scratch for iOS and Android platforms with an intuitive user interface

### Technologies

AWS cloud / React Native / Python (Flask) / REST API / JavaScript / MySQL

# Solution

## ★ 01

Dedicated Back-End and React Native engineers worked hand-in-hand to specify details and build client-server architecture at each project stage.

## ★ 02

Considering a clear understanding of the Client's business need, a state-of-the-art technology approach was implemented to amplify innovation in the application.

## ★ 03

The app offers quick user feedback and stores the data on the server.

## ★ 04

The scent footprint could be analyzed with a machine learning algorithm to identify its components. Scent analysis helps identify possible deviations from the norm.

## ★ 05

As a reliable and scalable cloud computing service, AWS was used to make the application more innovative.



## Client Reference



*The Intetics team's efforts were crucial in developing our mobile application, overcoming UX/UI design challenges, and implementing a unique scent recognition feature. Their state-of-the-art technology approach ensured innovation, exceeding our expectations and significantly enhancing user experience while adding substantial business value.*

## Benefits and Results

- ★ The Client received a mobile application built from scratch with tight timeframes and dynamic project specifications.
- ★ The developed user interface simplifies interactions and offers a unique customer experience.
- ★ The new unique mobile app revolutionized the wellbeing industry's approach to the child care.
- ★ With this innovative application, the Client broadened its market reach and boosted customer acquisition.

### Techstack:

AWS cloud, React Native, Python (Flask),  
REST API, JavaScript, MySQL

### Team: 8

Project Manager,  
Senior Software Engineers,  
Senior QA Engineers

Chapter 4

# AI-Driven Logistics

(#MLOps)



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### Business Domain

Education and eLearning

### Project Type

Enterprise Resource Planning

# Accelerating Delivery: MLOps Transformation for Global Logistics

## Client

A multinational logistics company operating a vast network of warehouses and transportation hubs worldwide.

## Project

MLOps transformation including the main components: MLOps infrastructure, CI/CD pipelines, automated testing framework, monitoring and governance tools.

## Objective

The Client's objectives included reducing time-to-market for model updates by 30% within 6 months, minimizing the risk of system failure through automated testing and deployment, ensuring scalability for a 50% workload increase without performance issues, and enforcing compliance with regulations such as GDPR and internal governance policies.

## Team Reinforcement

The Client required an experienced vendor with MLOps expertise to:

- Implement a robust CI/CD pipeline to automate the deployment of ML model updates.
- Develop an automated testing framework to detect regressions and ensure model performance.
- Set up monitoring and governance tools to track model performance, detect anomalies, enforce compliance.

## Challenge

The Client delegated Intetics providing MLOps services, enabling seamless management and optimization of machine learning models.

The Client encountered delays in rolling out model updates due to manual deployment processes. Additionally, lack of automated testing resulted in regression issues and system breakages.

The Client faced limited scalability of existing infrastructure to handle increasing workload demands.

Also, compliance gaps with regulations and internal governance policies due to manual oversight and lack of monitoring tools.

### Quick Facts

- ✓ Duration: 6 months
- ✓ Budget: \$300,000
- ✓ Stakeholders: Data scientists, IT operations team, compliance officers, executive leadership
- ✓ Expected ROI: 30% reduction in time-to-market, 20% decrease in system downtime, enhanced compliance adherence

### Technologies

**Cloud Platform:** AWS / GCP / Azure

**CI/CD Tools:** Jenkins / GitLab CI/CD

**Automated Testing:** Selenium / pytest / MLFlow

**Monitoring Tools:** Prometheus / Grafana

**Governance Tools:** SonarQube / AWS Config

## Solution

### ★ 01

#### **CI/CD Pipeline Implementation:**

Jenkins/GitLab CI/CD pipelines were set up to automate the deployment of ML model updates, ensuring faster time-to-market and reduced manual intervention.

### ★ 04

#### **Monitoring and Governance:**

Implemented Prometheus and Grafana for real-time monitoring of model performance and data drift, and AWS Config for governance, ensuring compliance with regulations and internal policies.

### ★ 02

#### **Automated Testing Framework:**

Developed automated tests using Selenium and pytest for code and MLFlow for model evaluation to detect regressions and minimize the risk of system breakage.

### ★ 05

#### **Continuous Improvement:**

Established feedback loops to capture insights from monitoring data and user feedback, enabling continuous improvement of the MLOps processes and infrastructure.

### ★ 03

#### **Scalability Optimization:**

Utilized cloud-native technologies on AWS/GCP/Azure to ensure scalability and elasticity, allowing the infrastructure to dynamically adjust to varying workload demands.



## Client Reference



*Intetics delivered outstanding results for our MLOps transformation project. They handled it proficiently, staying within budget and meeting tight deadlines. Their efforts significantly boosted our digital capabilities, driving efficiency and adding substantial value to our business operations.*

**Head of Digital, Data & Innovation**

### Benefits and Results

- ★ Achieved a 30% reduction in the time required to update models, resulting in faster deployment of improvements and updates.
- ★ Reduced the likelihood of system failures by implementing automated testing and deployment processes, ensuring smoother operations and fewer disruptions.
- ★ Successfully handled a 50% increase in workload without experiencing performance degradation, enabling the system to adapt to growing demands.
- ★ Maintained regulatory compliance with GDPR and internal policies, reducing legal risks and preserving trust with customers and stakeholders.

#### Techstack:

Cloud Platform: AWS  
CI/CD Tools: Jenkins, GitLab CI/CD  
Automated Testing: Selenium, pytest, MLFlow  
Monitoring Tools: Prometheus, Grafana  
Governance Tools: SonarQube, AWS Config

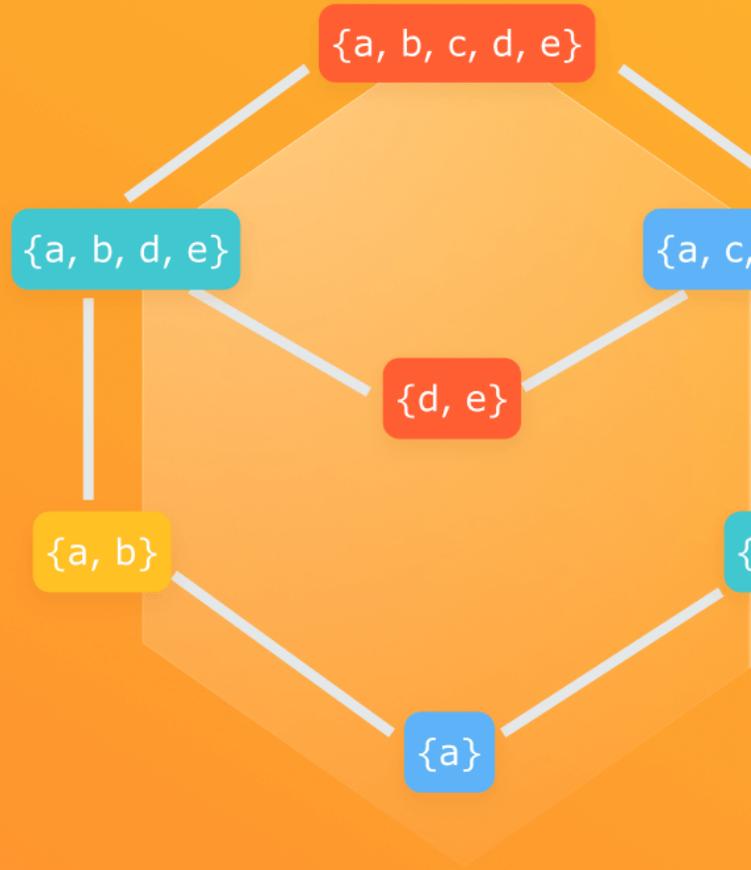
#### Team: 5

Project Manager, MLOps  
Architect, 3 MLOps Engineers

Chapter 5

# AI in Education

(#NLP #GenAI)



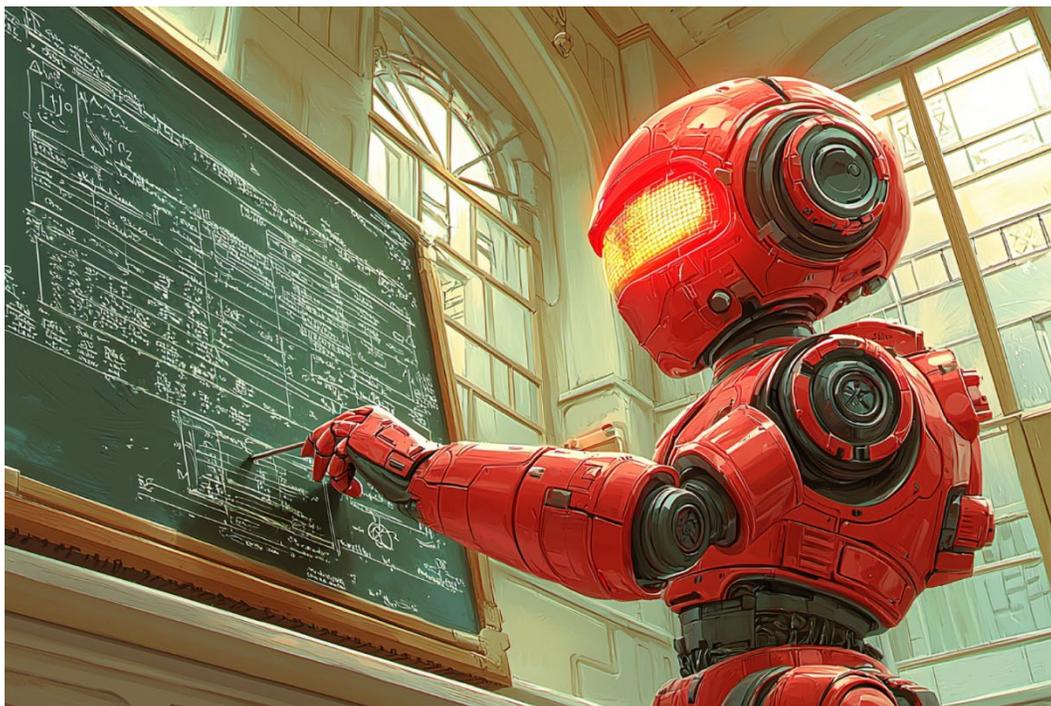
# AI in Education – Looking to the Future of Learning

## Introduction

AI in EdTech (AIED) is gaining traction, mainly due to rapid global digitalization and the widespread use of smart devices. AIED applications combine machine learning, deep learning, and advanced analytics to determine and monitor students' learning processes – for instance, test scores and individual learning speed. Technology can help provide students with personalized learning experiences, allowing them to absorb and retain materials at their own pace. Teachers can leverage AIED to better understand their students' baseline levels, strengths, weaknesses, and rate of progress over time.

Teachers, parents, students, governments, and regulators must recognize the potential AIED has to transform education. As the world's technological landscape evolves, our schools will change. AIED is poised to improve the learning process in primary and secondary schools, as well as in higher education. Overall, the global AIED market reached \$1.1 billion in 2019 and is forecast to reach [\\$25.7 billion by 2030](#).

In this White Paper, we will examine the AI applications in EdTech, how the technology works, its market volume, relevant educational materials, and more.



### Definition of AI in Education (AIED)

The use of AI in education has been researched for over 30 years. This field investigates learning no matter where it occurs – be it in a traditional classroom, in the workplace, through formal education, or lifelong learning. AIED brings together AI (which is inherently interdisciplinary) and pedagogy (including linguistics, education, neuroscience, psychology, anthropology, and sociology). Its end goal is to produce adaptive learning environments and inclusive, engaging, personalized, and flexible study tools.

Furthermore, AIED can give us a deeper insight into how individuals learn – for instance, it can provide data on how a learner's performance is impacted by their physical capabilities, socio-economic status, and the technology available to them. This insight can then be used to develop future AIED software, and it may also drive approaches to learning that don't involve technology.

## Scope of AIED – Looking to the Future

A lot of "e-learning" currently involves uploading offline content to an online space; as it isn't interactive or engaging, it cannot effectively address students' needs. It's not that school districts don't have their students' best interests in mind; rather, there is a lack of funding and little accessible information on how educators can implement AI technology.

With machine learning, artificial intelligence, and other emerging technology, educators can monitor and control their learning environments more effectively than they could in the past. Therefore, there is a need to redesign and realign core learning processes to leverage these technologies and effectively improve learning efficiency. This process will raise learning standards at scale, as well as optimize costs.

One such practical example is the creation of virtual learning environments that are more conducive to teachers. Let's look at VIPKid, an English language teaching platform based in China. On this platform, any native English speaker can sign up to provide instruction to primary students. They use a pre-designed curriculum and provide regular feedback after classes. Giving feedback can take a significant amount of time, as VIPKid teachers can have large, ever-changing student rosters. This is where AI could come in. Machine learning could automate the feedback process, leaving teachers with more time to improve the quality of their lessons.



We could take it even further – machine learning could provide [personalized lesson plans](#) for students based on their learning progress and needs. Since teachers often give lessons in a 1-on-1 or small group format, this could be the ideal solution for providing tailored content.

The above is just one example of how an online educational space could use machine learning and other AI processes to provide engaging, individualized instruction.

## Main Application Areas

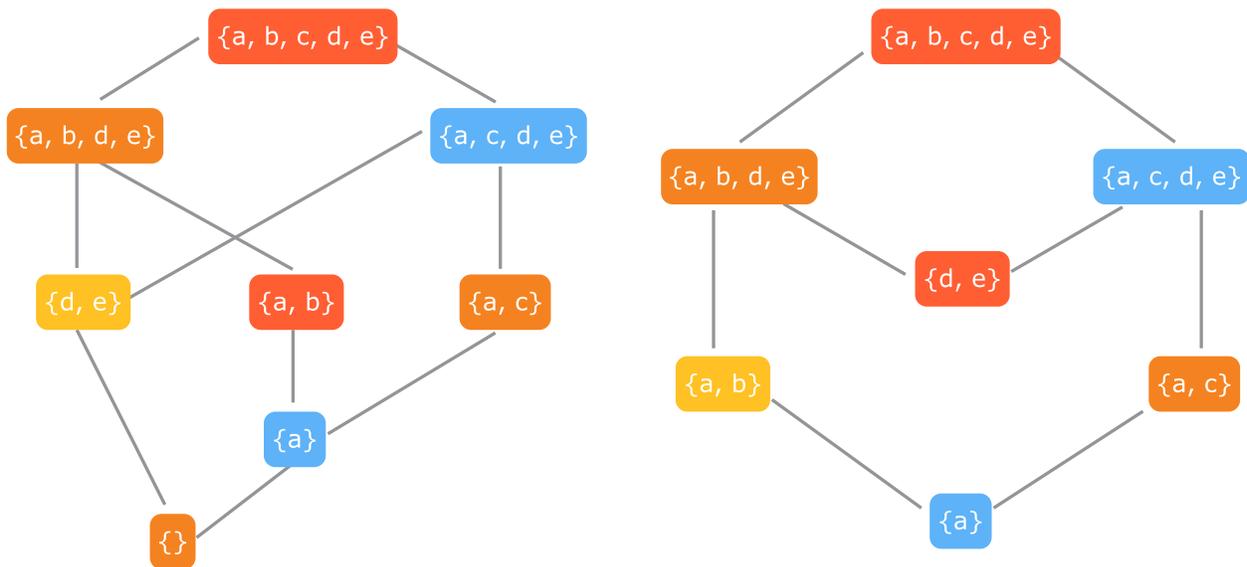
In traditional formal educational environments, students are taught in large groups. They all have varied needs – yet they receive the same instruction from one individual teacher. Unlike teachers, AI systems can scale quickly and efficiently to provide educational differentiation based on real-time sensory inputs. AIED systems can recommend suitable content, learning paces, and instruction methods for any individual learner at any given time.

Adaptive learning, which is often used alongside personalized learning, refers to an AIED system's ability to adapt to a learner's changing needs in real-time. Machine learning enables these systems to take newly introduced data into account and re-craft statistical models. These are the capabilities of AIED systems, but how can they be applied to transform study processes?

### Personalizing Education

AI can determine what a student does and does not know, and it can then use that information to build a study schedule addressing those knowledge gaps. This application allows students to increase their studying efficiency, so they only spend their limited learning time on areas that need improvement.

To train AI systems to provide personalized education plans, the Knowledge Space Theory comes into effect. It defines and represents knowledge gaps while at the same time considering the relationships between each gap (for instance, one area can stimulate learning in another area).



### Producing Smart Content

Currently, smart content comes in three main forms: digital lessons, information visualization, and learning content updates.

- **These digital lessons contain** bite-sized training and study guides generated with the help of AI. These, as well as digital textbooks, are combined into a digital learning interface.
- **This information visualization** refers to innovative, AI-powered methods of perceiving information, such as web-based study environments and simulations.
- **These learning content** updates use AI to generate and update lesson content, ensuring that all educational material is up to date.

## Contributing to Task Automation

AI can help simplify administrative tasks typically done by teachers, such as grading, assessing, and providing feedback to students. By entrusting routine tasks to AI, teachers free up time for more complex tasks, such as improving lesson quality, self-education, and grading assignments that AI can't tackle.

## Providing Tutoring

AI tutors are excellent time savers; as personal assistants or chatbots, these systems can provide students with additional support without placing an extra burden on the teachers. This also addresses the fact that many students are embarrassed to ask their teacher for help in front of classmates, and their parents may not have the spare time to assist in explaining concepts after school. With an AI chatbot, a student's queries are kept private.

## Ensuring Accessibility

AIED applications open up new possibilities for teaching students with learning disabilities or other special needs. For instance, Automatic Speech Recognition (ASR) technology helps universities produce transcriptions and captions for videos quickly. For example, BYU Idaho used ASR technology to reduce their media captioning wait-time from months to mere days. Deaf and hard of hearing students could receive immediate access to YouTube videos, lectures, TedTalks, and other audiovisual content.

However, AI in EdTech is not without its difficulties; some problem areas include:

- » Available datasets are limited; this, in turn, limits the resulting AI progress.
- » Current AI EdTech applications do not pay close enough attention to learner differences and equity.
- » AI technology can be costly and strain a school district's already overly-extended budget.
- » There is often bias present in data.



# Technology Overview

## Glossary of Common Terms

### **Adaptive Learning Environment**

A virtual learning environment that modifies learning approaches and teaching methods to meet the needs of individual learners.

### **Big Data**

Data sets that are too big and complex for simple algorithms to analyze. They require machine learning or more complex data analytics to gain usable insight from them.

### **Machine Learning**

This is one way to create AI: a computer system that learns from data instead of following a ruleset. When given enough data, machine learning algorithms can learn to solve problems and make predictions.

### **Neural Networks**

A form of AI that takes inspiration from the human brain: it is created using artificial neurons or processing nodes, which are layered. Each node is given data from the nodes above it – and then passes the data down.

## Categories of AI in EdTech

There are three main categories of AI in EdTech: learner-oriented, instructor-oriented, institution-oriented.



### Learners

Learner-oriented AI provides a personalized or adaptive learning management system, enabling students to study a subject domain effectively. Such platforms may facilitate the collaboration between learners, give automated feedback on simple responses, diagnose knowledge gaps, and curate/stagger learning materials based on learner needs.

Granted, sophisticated AI is not required to complete all of those tasks; rules-based programs can offer adaptive learning. However, advances in machine learning have made more sophisticated learner-facing EdTech platforms possible. For instance, rather than making students follow one of a set of human-designed learning paths, machine learning algorithms use a student's strengths, weaknesses, and knowledge gaps to scaffold individualized learning.



### Instructors

Instructor-oriented AI tools can automate administrative procedures, plagiarism detection, assessments, and feedback provision. Furthermore, instructor-oriented systems can monitor learning progress and flag instances where teacher intervention is required. Teachers now have time for innovation and experimentation with different teaching methods; what's more, they now have concrete evidence showing these methods' effectiveness.

Although some parents are concerned that AIED seeks to replace teachers altogether, this is likely not possible in the foreseeable future, nor would it be desirable. As Rose Luckin notes in *Intelligence Unleashed*, "teachers will be the orchestrators of how and when to use AIED."



### Institutions

Institution-facing (or system-facing) AIED helps school administrators and district leaders predict inspection performance, organize timetables, see and anticipate biases inherent in big data sets, and measure a student's suitability for a school during the admission process. Currently, institution-facing AIED is the least widespread out of the three varieties.

## How AI in EdTech Works

AI involves computer software that can interact with the world in a manner that would usually require human intelligence. This means that AI requires knowledge about the world and algorithms capable of processing that knowledge. Take, for instance, an AIED system that needs to give a student appropriate, personalized feedback. In order to be successful, the AIED system must have knowledge of effective teaching approaches, the academic subject, and the student.

"Models" contain the knowledge necessary for an AI system. There are three key models in AIED: pedagogical, domain, and learner.

### Pedagogical Model

**What it represents**

Knowledge of the teaching process

**Examples of specific knowledge**

Assessment for informing and measuring learning, feedback triggered by student input, productive failure

### Domain Model

**What it represents**

Knowledge of the subject matter

**Examples of specific knowledge**

Causes of World War II, how to multiply fractions, how to structure an argument in an essay

### Learner Model

**What it represents**

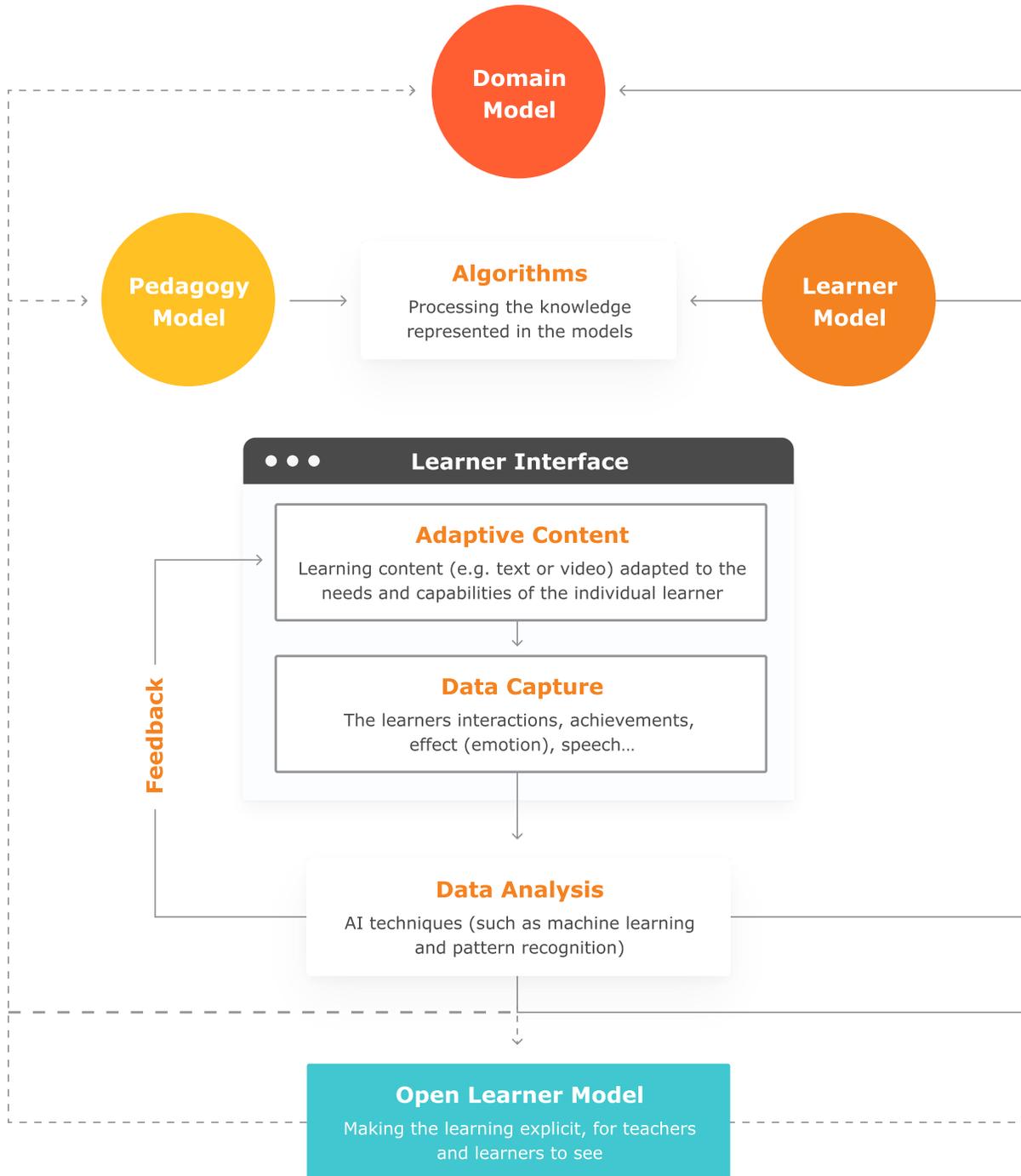
Knowledge of the learner

**Examples of specific knowledge**

The student's emotional state, accomplishments, weaknesses, and learning engagement

## What AIED Technology Looks Like

The figure below shows a simplified depiction of a standard model-based, adaptive tutor. It uses the three core models (pedagogy, learner, and domain) – then AIED algorithms process the knowledge and select the content to deliver to the student.



Content delivery could be in the form of a video, an activity, a sound, an animation, or a piece of text. Regardless of the form it takes, it is selected for its relevance to the individual's capabilities and needs. While the content is being delivered to the student, the system continuously analyzes that learner's interactions and provides feedback. Interactions might include their current answers and actions, past achievements, or information on their psycho-physiological state.

A deep analysis of these interactions helps the student progress through content and updates the learner model accordingly. AIED technology can more accurately estimate a student's current state (including their motivation and understanding) and ensure that the learning experience is fully customized to their needs.



Some systems use Open-Learner Models; these present analysis outcomes back to the students and teachers. These outcomes contain valuable information that helps teachers understand their students' learning approaches better – thus enabling them to shape future learning experiences accordingly. Learners can also benefit from this model, as they can track their own progress and reflect on their learning journey.

## Key Players Involved

The [top AI-based EdTech providers](#) include:

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Google</b>	<b>Microsoft</b>	<b>[24]7.ai</b>	<b>eGain</b>	<b>next IT</b>
Google Inc.	Microsoft Corporation	IntelliResponse System Inc.	eGain Corporation	Next IT Corporation

Of course, there are far more significant players across various niches, including Jobs & Upskilling, Assessment & Credentialing, Learning Content & Resources, Management Systems, Learning Environments, and more.

**JOB'S & UPSKILLING**

APDS, BetterUp, CareAcademy, degreed, Forage, Handshake, LEARN IN, Lessonly, MasterClass, OpenSesame, PATHSTREAM, Platzi, pymetrics, Riipen, SVAcademy, SKILL SHARE, THINKIFIC, UDACITY, TRANSFRVR, Udemy, yearup, YELLOW BRICK

**LEARNING ENVIRONMENTS & STUDENT SUPPORT**

campuslogic, Clever, Course Hero, Mursion, nearpod, Quizlet, showbie, skilljar, STRIVR, TOP HAT, Varsity Tutors, wyzant

**LANGUAGE LEARNING**

duolingo, ELL ELEVATION, grammarly, Preply, voxy

**UNIVERSITY PARTNERSHIPS**

Academy, ApplyBoard, AdmitHub, collegevine, coursera, edX, GUILD, InStride, MINERVA, NOODLE, SHORELIGHT, Study.com

**ASSESSMENT & CREDENTIALLING**

Credly, formative, fresh grade, examity, proctoru

**2020 NORTH AMERICA EDTECH**

**100**

Holon IQ www.holoniq.com

**STEAM & CODING**

desmos, dreambox LEARNING, Knowledgehook, photomath, Prodigy, replit, SOLO LEARN

**LEARNING CONTENT & RESOURCES**

BL, Age of Learning, BEG!N, BetterLesson, edpuzzle, epic!, hellosaurus, Khan Academy, newseia, Panopto, Teachers Pay Teachers

**MANAGEMENT SYSTEMS**

BrightBytes, ClassDojo, CIVITAS LEARNING, classtag, FRANK., remind, ReUp, securly, Vemo

**BOOTCAMPS & ALTERNATE MODELS**

FOUNDRY COLLEGE, KENZIE ACADEMY, codecademy, Outlier, Outschool, Lambda, straighterline, treehouse, Springboard, tinkergarten, VERTO EDUCATION

**WELLNESS & MENTAL HEALTH**

EVERFI, ginger, PANORAMA, Thriver, spring health

HoloniQ - December 2020

## History of Development

Though AI in Edtech has flourished over the past decade, researchers began to delve into this area in the 1970s. Eliza, an early NLP program built in the 1960s, was incorporated into Jaime Carbonell's SCHOLAR – a student-facing instructional program. SCHOLAR asked questions on South American geography and then provided natural language feedback on the quality of the student's response.

Another significant AI EdTech prototype was MYCIN, which helped physicians diagnose bacterial infections and prescribe therapies. This system was embedded with tutoring approaches so that knowledge would be accessible to physicians. This model paved the way for Intelligent Tutoring Systems (ITS).

Initially, ITS was very rudimentary. Rather than using machine learning, the systems followed step-by-step programmed learning paths. Then, in the 1980s, pedagogy became more important. This was when the [BUGGY](#) approach was born, working under the assumption that students have "bugs" in their thinking. Nowadays, we call such bugs "misconceptions." A bug library was created in 1975 by J.S. Brown and R.R. Burton, attempting to break down a task into smaller components, reproduce the student's behavior, develop a diagnostic model, and then identify procedural bugs the student might acquire when solving problems. The teacher then used BUGGY's feedback to diagnose and "treat" the student bug.

In the 1990s, dynamic student models came onto the scene. These models paid greater attention to what the student learned over time, and they used that information to update the dynamic student model. Significant focus was placed on providing relevant hints and feedback.

In the 2000s, AIED used Bayes Nets, Artificial Neural Networks, and other AI approaches to form the educational data mining field. This refers to tools designed to automatically extract insight from large datasets related to learning activities in an academic setting.

## The Market

According to [PS Market Research's AI in Education Market Report](#) (Feb 2020), the 2019 global AIED market size was 1.1 billion. The market is predicted to achieve a 32.9% annual growth rate between 2020 and 2030 and reach \$25.7 billion by 2030. The key factors driving the market include the ever-growing need to provide personalized, AI-based education and to automate administrative tasks.

### GLOBAL AI IN EDUCATION MARKET



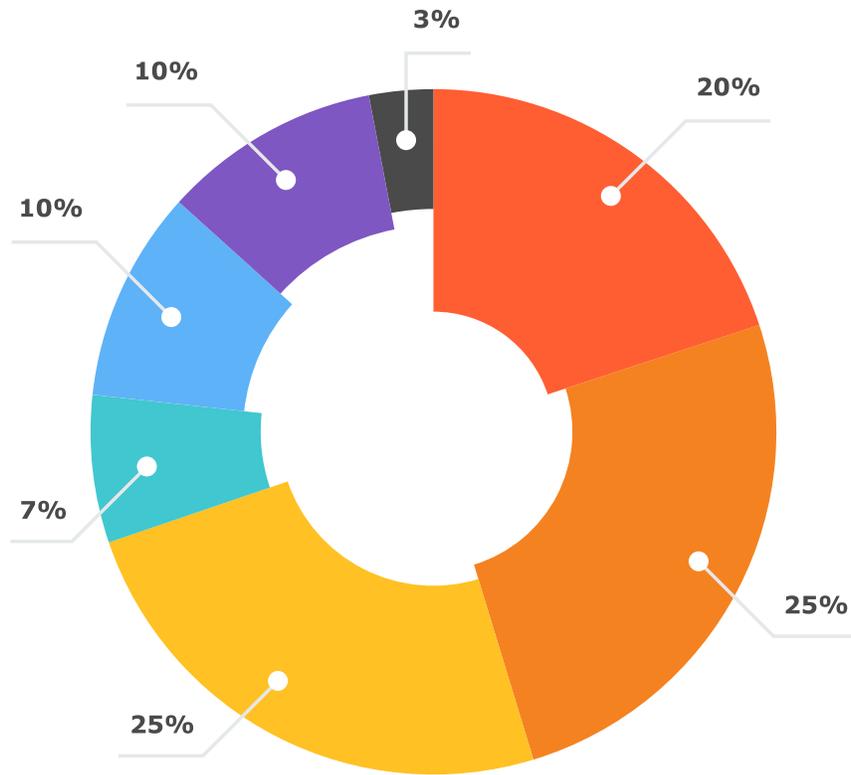
**2019**  
Market Size  
**\$1.1 billion**

**2030**  
Market Size  
**\$25.7 billion**

Market Growth Rate  
(2020-2030)  
**\$32.9%**

According to Deloitte's report on the [Global Development of AI-Based Education](#) (2019), the most common services provided by the Top 30 AI Edtech companies are K12 (25%), Higher Education (25%), Quality-Oriented Education (20%), Language Learning (10%), Reading (10%), and Corporate Training (7%). The "Other" services account for only 3% overall.

**PERCENTAGE OF TOP 30 "AI + EDUCATION" COMPANIES PROVIDING THE FOLLOWING SERVICES**



- Quality-oriented education
- K-12
- Higher education
- Corporate training
- Language learning
- Reading
- Others

Source: iyiou.com, Deloitte Research

**The Competitive Landscape of the AIED Market**

Google, Blackboard, Microsoft, IBM, Carnegie Learning, and other major players in the AI EdTech market have been ramping up their partnerships and product launches. Take, for instance, IBM's collaboration with Edmodo in 2018. They collaborated to create a personalized recommendation engine for Edmodo's education platform. Using the [IBM Watson Classroom Cognitive Library](#), teachers can provide customized content recommendations to students based on their performance.

## How It Works

To train a deep neural network model, you must use a highly tuned system with carefully selected drivers, software, computing power, memory, network, and storage resources. One such system is Fabric for Deep Learning (FfDL). It offers a stack that enables data scientists to use the deep learning framework of their choice to execute training jobs at scale in the cloud. FfDL allows scalability, multi-tenancy, resilience, and security without modifying the desired deep learning frameworks – and with little to no changes to the model code. FfDL can be used with PyTorch and TensorFlow frameworks, which we will discuss in the following core section, Main Tech Architectures Used.

### FfDL Architecture

FfDL uses microservices architecture: essentially, with this architecture, an application is structured as a collection of services that are:

- » Organized around business capabilities
- » Independently deployable
- » Highly maintainable and testable
- » Loosely coupled

These microservices include:

#### REST API

This microservice takes care of REST-level HTTP requests while acting as a proxy to FfDL's lower-level Trainer service. The REST API also handles authentication and load-balance requests.

#### Trainer

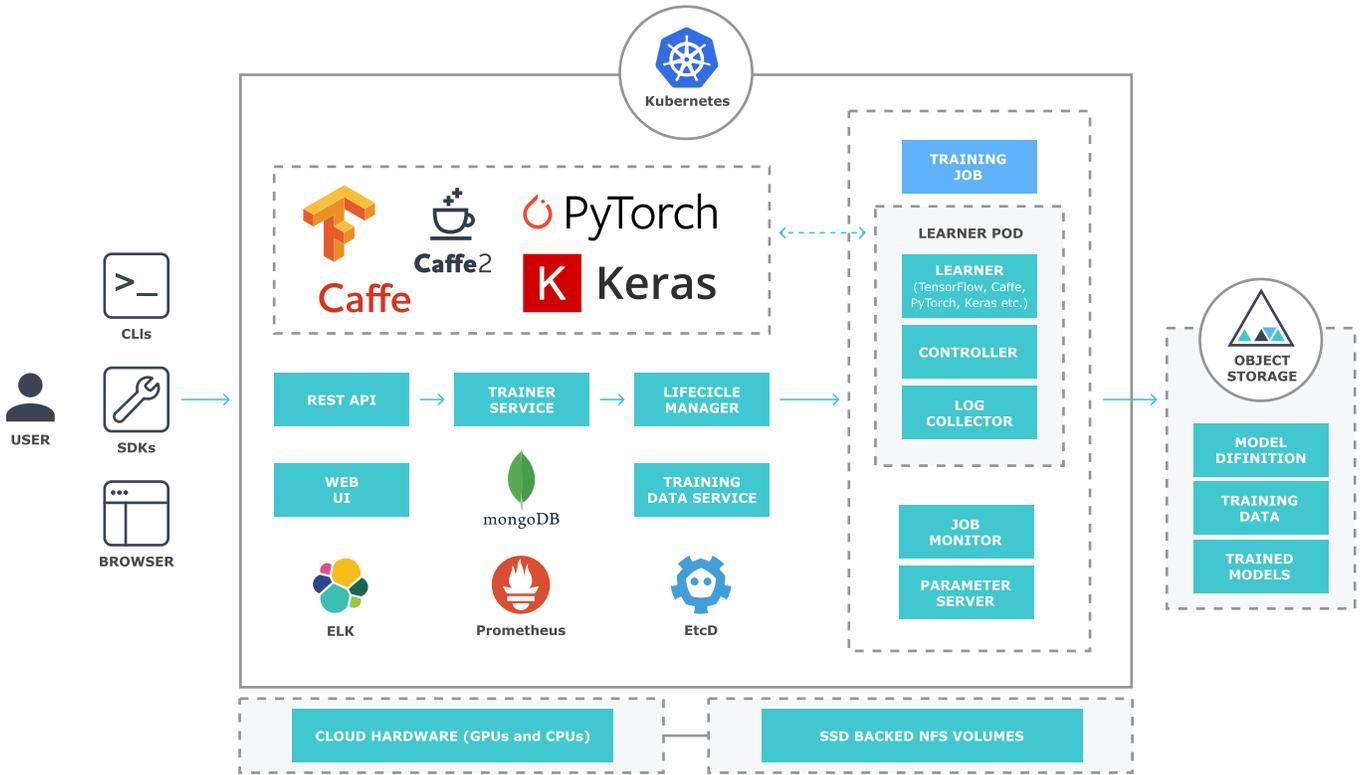
This microservice admits training job requests, model input configuration, and persisting metadata to the MongoDB database. Trainer initiates job deployment, halting, and user-requested termination by calling Lifecycle Manager's appropriate gRPC methods, which we will look at momentarily. Trainer also gives each job a unique identifier, used for tracking purposes by all other components.

#### Lifecycle Manager (LCM)

It halts and terminates training jobs, and it also deploys training jobs that arrive from Trainer. LCM uses Kubernetes cluster management for deployment; each job consists of a set of interconnected Kubernetes pods - and all of the pods contain at least one Docker container. LCM determines the learner pods, interconnections, and parameter servers based on the job's configuration. It then calls on Kubernetes to deploy the job.

#### Training Data Service (TDS)

When a learning job is running, training data is extracted from the learner and pushed into TDS, then feeding said data into Elasticsearch for future retrieval.



## Diving Into the Technical Details

Two of the most popular deep learning frameworks are [TensorFlow and PyTorch](#).

### Key Facts About PyTorch:

- Developed by Facebook's AI Research Lab
- Released in 2016
- Meant to be used in Python but also has a C++ interface
- Has dynamic computation graphs
- Supports CUDA (Compute Unified Device Architecture)



### PyTorch Case Study

Erin Song, a STEAM teacher from North Carolina, used Pytorch to create MineTorch: a platform that teaches children how deep learning works. Minetorch was Song's entry for a "[hackathon](#)", in which 77 contestants had 48 hours to build a project in PyTorch. Key Facts About TensorFlow:

#### Key Facts About TensorFlow:

- Developed by Google's Brain Team
- Version 1.0.0 was released in 2017
- Provides workflows to develop and train models using Javascript or Python
- High-level Keras API for deep learning practitioners working in Python
- Graph construction is static, unlike PyTorch

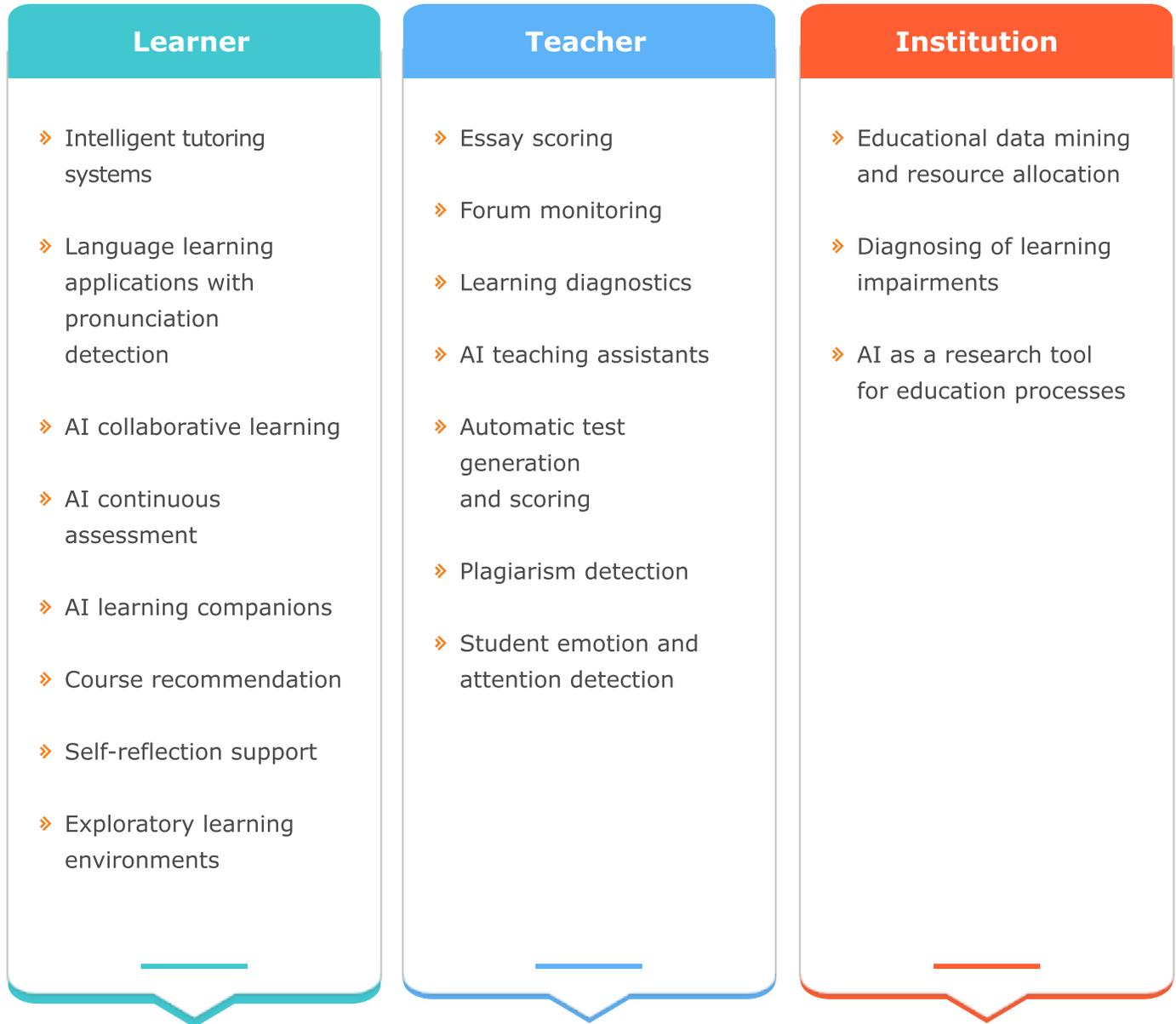


### TensorFlow Use Case

AI can be used to grade students' handwritten assignments. Gradescope is one such example: this online grading app from UC Berkeley can identify single-word, numerical, and one-line answers. To train the algorithm, developers use Tensorflow and CuDNN (a deep neural network library). Teachers can use Gradescope to shorten grading time by up to 75%.

## Main Applications and Impact Delivered

AIED is, as mentioned earlier, categorized into learner-oriented, teacher-oriented, and institution-oriented applications. Now, we'll take a closer look at the specific types of applications in each category.



## Institutional AIED Case Study: Intetics Creates a K-12 IEP Management System

A provider of special education services and software had an outdated product that helped schools automate the management of Individual Education Planning (IEP) forms. These forms contained crucial information about students with disabilities and what school services they needed. Form management needs to be accurate, timely, and compliant with government requirements. Therefore, the client desired system modernization in accordance with the new technologies stack.

After analyzing the client's requirements, Intetics put together a dedicated offshore team of software engineers responsible for database and software development, system architecture, data entry, and testing.

After the team modernized the existing application, they developed new features for the product, which were created as modules. The final product automatically files health forms, scans and recognizes paper-filled forms, manages IEPs, completes smart scheduling of activities, and much more. The interface is user-intuitive and designed for easy access by district administrators and medical professionals alike.

### The primary outcomes of this use case are:

★ 01

The client now has more time to focus on providing quality service and fulfilling business requirements rather than getting caught up in technical details.

★ 03

The platform is compliant with local regulations and HIPAA requirements.

★ 05

District IEPs can now accurately streamline, create, and control student checkups.

★ 02

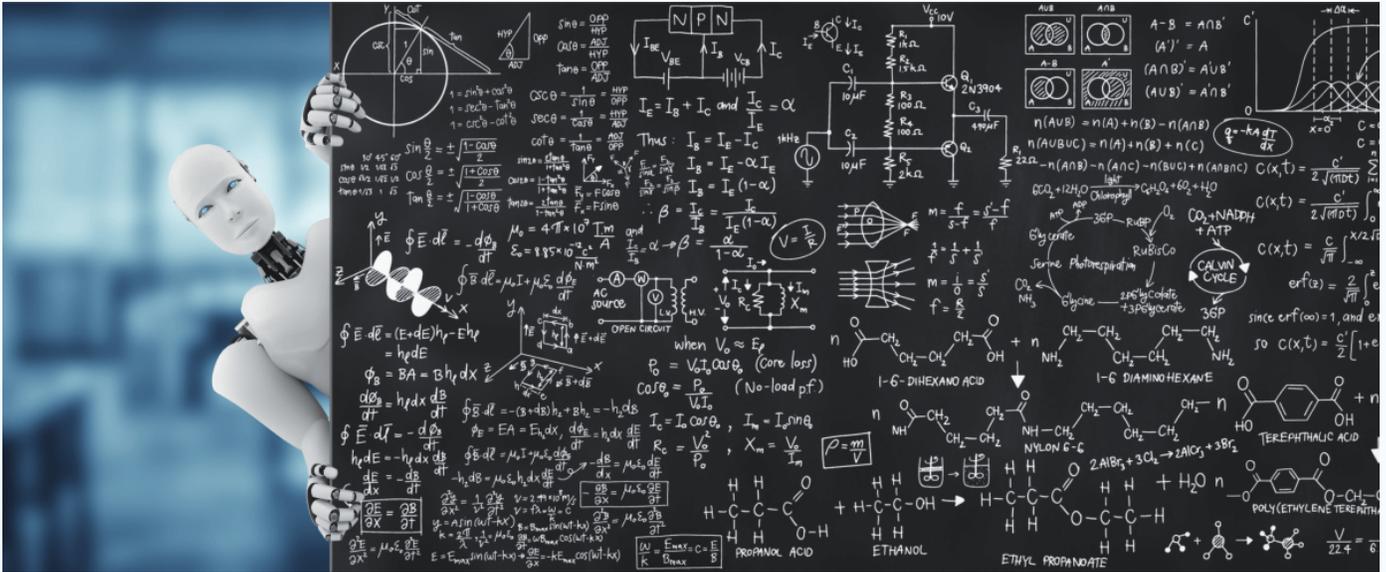
School districts now have better document automation, improved Medicaid access, and more scheduling options.

★ 04

The product can be used as a major migration platform for related projects.

★ 06

The client has become a market leader in IEP management software and expanded into 13 states.



## Teacher AIED Case Study: Intetics Creates a Learning Management System for a Tutoring Company

A tutoring company was notified that their vendor would terminate their subscription-based service in 12 months. The tutoring company contracted Intetics, desiring a complex ERP system that could manage all business activities. The timeline was quite limited, as the new solution would need to be fully implemented before the vendor canceled the existing subscription.

Intetics analyzed the vendor's software and noted the required modifications that could not be made in the old version. Intetics' development team created a solution that would meet the client's business needs and support new features. The developed solution offers:

- Management of all business activity from one system
- More comprehensive data analysis
- Streamlining of business processes
- An improved customer experience

## Student AIED Case Study: Intetics Creates a Test Content Management System

Because of COVID, students are temporarily unable to take tests in large group settings. Therefore, educational organizations need digital solutions so that students can take their tests online. Intetics' client helps students prepare for such tests, and to do this effectively, they require a digital test platform that can match the UX/UI of the actual tests.

Intetics created a test content management system that contained all major test types: ACT, SAT, PSAT, and ISEE. When students take a test using this system, they have a near-identical user experience to the original digital test. What's more, the score results are available in just a few minutes. The Intetics team is continuing to add new features to the platform.

## Standards Applied

Currently, there are no concrete standards in use for AIED. However, the world's first international standards committee, [ISO/IEC JTC 1](#), is working to standardize the entire artificial intelligence ecosystem. The committee was created in 2018 and has a goal of providing guidance to ISO, JTC 1, and IEC committees that develop AI applications. Some standards under progress include:

- » [Reference architecture of knowledge engineering](#)
- » [Data quality for analytics and ML](#)
- » [Guidelines for AI applications](#)
- » [Risk Management](#)

Published standards include:

- » [Big data reference architecture](#)
- » [Trustworthiness in artificial intelligence](#)

## Industry Resources

Some associations and magazines for AI practitioners include:

- » [Association for the Advancement of Artificial Intelligence](#) (AAAI)
- » [AI Magazine](#)
- » [Emerj Artificial Intelligence Research](#)

Some associations and magazines for AI practitioners include:

- » [International Society for Technology in Education](#) (ISTE)
- » [Edu-Tech Business Association](#)
- » [International Conference on Artificial Intelligence in Education](#)

## Authorities

These companies are paving the way for the innovative merger of AI and organic learning systems:

1

**Knewton** creates adaptive learning technology for college-level education. Its program, "Alta," identifies the gaps in a learner's knowledge, provides relevant study material, and helps the students get back on track in their college-level courses. Currently, this program is used for chemistry, statistics, general math, and economics.

2

**Cognii** created AIED products for K-12, higher education, and workplace settings. Cognii's virtual learning assistant uses conversational technology to present students with questions that foster critical thinking. Questions are open-format rather than yes/no, and feedback is provided in real-time. What's more, the answers are used to develop and implement one-on-one, customized AI tutoring.

3

**Querium** delivers AI-enabled STEM tutoring lessons to college and high school students. Querium's AI analyzes answers and session length; then provides teachers with insight into their students' learning habits and areas for improvement.

4

**Century Tech** launched a platform that combines data analytics with cognitive neuroscience; it harnesses this power to create personalized learning plans, thus reducing teachers' workloads. The platform can track progress, identify gaps in knowledge, and provide feedback and study materials.

5

**Kidaptive's Adaptive Learning Platform (ALP)** is making big waves in AIED. The platform uses AI algorithms to collect learner data and improve engagement. AI is also used to challenge students relative to their strengths and weaknesses. Furthermore, the platform analyzes underlying patterns and relationships to predict future academic performance.

## Certifications

While there are currently little to no available certifications specifically for AIED, there are plenty of general certificates for AI professionals. These include:

- [The Artificial Intelligence Engineer Certification by Artiba](#)
- [Machine Learning](#) by Stanford University
- [Applied AI Professional Certificate](#) by IBM
- [MicroMasters® Program in Artificial Intelligence](#) by Columbia University

## Your Health Check

Are you unsure whether your EdTech solution needs to be AI-powered? Work through the following checklist to determine if you can benefit from AI:

### 1. Does your solution provide personalized learning?

AI can determine gaps in a student's knowledge and create a customized study plan.

### 2. Are you producing Smart Content?

Digital lessons, learning content updates, and innovative information visualization can all be powered by AI.

### 3. Do you need to automate repetitive tasks?

Providing feedback, giving assessments, and grading homework are time-consuming activities – but AIED can handle this instantly and with personalization. By automating such tasks, teachers now have more time for improving their lesson quality.

### 4. Are you trying to improve student engagement?

Personal content recommendations, custom tasks, digital interaction, and individualized schedules help each student feel special, thus raising their engagement and interest in the content.

### 5. Do you need to reduce pressure on students?

Students may choose not to ask for help when classmates are around – by asking the teacher aloud; they could face teasing. But with an AI-powered virtual assistant, students can discreetly ask questions and receive a comprehensive, expert answer. And, by reducing that pressure, students have less stress and more motivation to study.

### 6. Do you want to use content analytics?

AI can analyze content taught to learners and determine whether it is of maximum effectiveness. Educators and providers can receive important insight on eLearning content.

## Further Reading

While this Whitepaper provides a general overview of AI applications in the education sphere, the following resources can provide deeper, more focused insight:

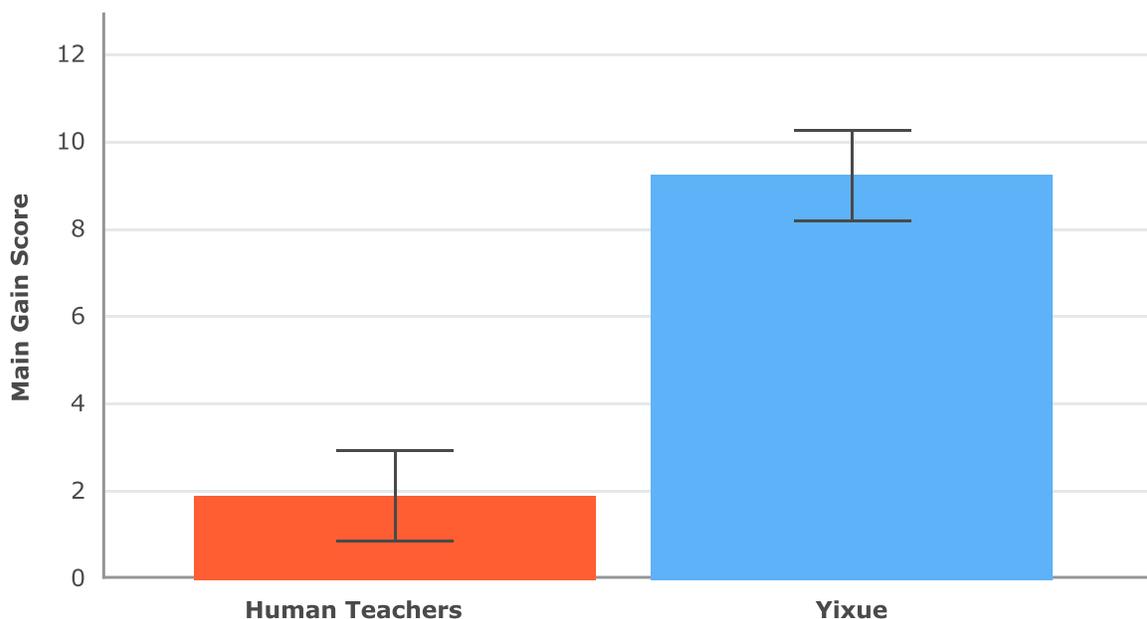
- [Artificial Intelligence Explorations and Their Practical Use in Schools](#): This 30 hour, self-paced course from ISTE offers ongoing instructor support. It is designed for middle and high school teachers, as well as school tech coordinators. No previous knowledge of AI is necessary; you will learn about the different kinds of AI, learn about upcoming AI innovations on the horizon, and build some basic AI tools of your own.
- [Artificial Intelligence In Education: Promises and Implications for Teaching and Learning](#) (Fadel, Holmes, Bialik, 2019): Learn how the emergence of AI has caused rapid changes in the landscape of education. The book takes a look at how school curriculums must be updated to accommodate an AI-driven world. Readers will also learn about how AI helps teachers become more effective and about various AIED applications.
- [TED Talk: How to Empower Education With Artificial Intelligence](#): Dr. Luca Longo, an assistant professor at the Dublin Institute of Technology, presents ways that AI can transform education.

## Miscellaneous

### China's Grand Exploration of AI Education

Over the past few years, China's investments in AI-powered education have skyrocketed. Education incumbents, tech giants, and startups have all hopped on board. Tens of millions of students across China are now using AI to learn through digital learning platforms, extracurricular tutoring programs like [Squirrel](#), or even in their principal, physical classrooms.

Interest is making its way westward: in 2019, Squirrel opened a joint research lab with Carnegie Mellon University. Their plans are to research personalized learning at scale and export it internationally.



Some experts are concerned that China is rushing towards AI in education. Poorly developed AIED solutions could make it more difficult for teachers to accurately identify and address their students' strengths, weaknesses, and interests. However, companies like Squirrel are yielding remarkable results in traditional education.

For instance, in a [3-day study](#) that measured 203 middle school students' test scores, Squirrel found that their AI tutoring system was better at lifting scores than experienced teachers. The students were split into two groups: the treatment group (which received AI instruction) and the control group (which received instruction from human teachers). Both groups received introductory content, filled out a questionnaire, and then took a pre-test. Afterward, they received instruction according to their group classification. Then they took a post-test. The results showed that students who received AI content showed 419% greater gains.

## Summary and Conclusions

AIED offers solutions to many educational challenges and can deliver learning experiences that are more personalized, inclusive, flexible, engaging, and effective. Not only that, but AIED can be applied to learning experiences in both formal and informal settings, during K12, higher education, lifelong learning, and the workplace.

Over the last decade, AIED has grown leaps and bounds; it has moved from lab work to large-scale deployments – yet, school districts aren't leveraging this technology as effectively as they could. One key reason that some educators and administrators remain skeptical is that they believe AIED has insufficiently rich learning models. One of the main focuses of AIED over the last ten years has been to develop incredibly comprehensive learner, teacher, and domain models – however, research on those models was typically only published in conference proceedings and specialist journals. This meant that the average teacher and school district could not see how AIED was evolving – only now is AIED's progress becoming more visible.

For AI to reach its full potential in educational settings, the AIED community needs to explain better the value and the nature of the models it uses.

AIED has made significant progress, but there are still plenty of exciting developments to come as the existing applications develop, mature, and scale. And the future of AIED isn't just "more of the same" – instead, developers are becoming more skilled at blending machine and human intelligence effectively. As AIED technologies evolve, we could see AI teaching assistants introducing new management and teamwork skills, AI applications teaching students 21st-century skills, such as financial literacy and cultural awareness, and even AIED incorporated into augmented reality systems.

Chapter 6

# AI in Retail

(#ComputerVision)

# Shape the Future of Retail with AI Integrated Virtual Try-On Solution

Affordable, enterprise-ready, and immersive shopping solution to boost e-commerce sales — meet AI integrated Virtual Try-On Solution for your business.



According to a [Salesforce survey](#), 88% of customers believe that a shopping experience is just as crucial as the quality of its products and services. One significant challenge is replicating the seamless experience of offline shopping on websites and mobile applications. While customers enjoy the convenience of online shopping, they often need to take advantage of the opportunity to physically interact with products before making a purchase decision.

This limitation has spurred the development of a transformative technology known as a [virtual try-on](#).

Delve deeper into virtual try-on technology and explore the different ways to enable your customers to try on millions of outfits, glasses, and jewelry from the comfort of their homes.

## AI Integrated Virtual Try-On: Solution Overview

Virtual try-on is an innovative technology that is changing the way customers experience online shopping. It uses augmented reality and advanced imaging to provide a realistic representation of how products will look on the customer's body or face. This allows users to virtually try on clothing, shoes, accessories, and cosmetics in a way that closely simulates the experience of trying them on in a physical store.

The concept of an AI virtual try-on tool has existed for years, with early experiments by brands like Converse dating back to 2012.

However, it gained significant momentum after the release of Pokémon Go in 2016, which sparked widespread interest and investment in AR technology. Since then, advancements in hardware, such as powerful phone chips, graphics processing units, and neural processing units, have greatly improved the capabilities of virtual try-on experiences.

Which brands have virtual try-on?

Frankly, many brands do. For example, Sephora [offers](#) a Virtual Artist tool that allows customers to virtually try on makeup products and experiment with different looks. Ray-Ban provides a feature for sunglasses, while Bailey Nielsen has a virtual try-on for jewelry. Other notable brands are Nike, Wacoal, L'Oréal, Farfetch, e.l.f. Cosmetics, Baume & Mercier, and Warby Parker.

## How It Works

Virtual try-on experiences include the following components:

- **Analysis of customer features:** The tool starts by analyzing the customer's image or video captured through the device's camera. Advanced algorithms and computer vision techniques are applied to determine the user's facial features, body proportions, and other relevant characteristics.
- **Product overlay and adjustment:** Once the user's features are analyzed, the chosen product is digitally overlaid onto their image or video. The technology adjusts the size, shape, and position of the product to align with the user's unique attributes. This ensures a realistic representation of how the product will appear when worn or used.
- **Real-time interaction and movement tracking:** These applications often provide real-time interaction so that customers can see themselves in the virtual product as they move or adjust their position. The technology tracks the user's movements, ensuring that the virtual product stays aligned and responsive to their actions.
- **Customization and personalization:** Virtual try-on apps can offer customization options to enhance the user experience, like changing colors, styles, and lighting with a simple tap or swipe. This allows users to explore different variations of the product and tailor it to their preferences.

**Find your perfect match now:** [Virtual Try-On Demo](#)

It's also optional for solutions to include additional features like basic photo editing tools. Or there may be in-app purchasing links, allowing users to directly purchase the products they like without leaving the app, or social media integration along the online try-on tab.

## How Your Business Can Leverage Virtual Try-On?

Virtual try-on technology can be leveraged across various industries and sectors where customers need to try on products on their bodies or visualize them in a specific space. Eyewear, makeup, and jewelry have been prominent adopters, but there are numerous other sectors recognizing the advantages of incorporating virtual try-on technology.

Namely, you can find great virtual try-on examples in fashion and apparel, home decor and furniture, the automotive industry, and interior design. But for now, let's explore the three key areas in which implementing virtual try-on is straightforward and yet profoundly impactful:

### Eyewear

[Virtual try-on for glasses & sunglasses](#) uses 3D facial models, uploaded photos, or even social media data to create a personalized experience. Users can see themselves wearing different frames and make confident decisions based on their unique facial features and style preferences.

One of the key advantages of a try-on tool for glasses is the precision it offers. Without any effort, anyone can accurately assess how frames will fit their face, considering factors like face shape, nose bridge width, and temple length. And if you want to seek feedback and opinions from others, showcase your try-on results with your followers on social media.

The solution also caters to individuals with severe myopia. The *"See your glasses without glasses"* functionality allows users to view themselves wearing frames without having to wear their prescription glasses. It's particularly beneficial for those with high levels of nearsightedness who struggle to see themselves clearly without corrective lenses.

### Makeup

Similarly, a [virtual makeup try-on](#) tool utilizes the user's camera to accurately analyze their skin tone, texture, and facial features. This analysis enables the software to recommend the ideal makeup products that complement the individual's skin tone and style. Recommendations aside, users can choose whatever else they like and virtually try on different shades of foundation, lipstick, eyeshadow, blush, and more to find the perfect match for their complexion.

Some applications integrate smart bands and GPS technology to gather additional information about the user's body and skin type. By leveraging this data, the solution can provide even more personalized makeup recommendations, tailored not only to how the person looks but specific parameters like skin sensitivity, oiliness, or dryness. Location and climate details can also be considered so that users can select products suitable for their environment.

## **Jewelry**

Virtual jewelry try-on offers a range of possibilities for users to digitally experience various types of jewelry. They can try on necklaces, chokers, and pendants, visualizing different styles, lengths, and designs to find the perfect piece that complements their attire and personal style. Additionally, these applications provide a precise representation of earrings, piercings, and ear cuffs. The technology also extends to bracelets, watches, and rings.

Putting all these possibilities together, if your potential customers have access to this functionality, it'll help them explore and find the perfect jewelry pieces wherever they are.

Another fun idea in the realm of virtual jewelry experiences is the concept of a jewelry studio for customization. This is a great way to explore a wide range of design options, including different gemstones, metals, and settings. Customers can mix and match these elements to create their own unique jewelry pieces, like rings, necklaces, earrings, or bracelets.

## **Benefits in Comparison with Existing Solutions**

Virtual try-on is a game-changer in the retail industry, bringing a host of [captivating benefits](#):

### **Reducing Returns**

A virtual try-on tool allows customers to visualize themselves in different styles and sizes before making a purchase. By eliminating the guesswork, customers can confidently select the perfect fit, which drastically reduces return rates. This not only saves businesses valuable time and resources but also enhances customer satisfaction.

### **Elevating Personalization**

Virtual try-on enables customers to experiment with various styles, colors, and combinations. This freedom to explore different looks empowers customers to express their personal style and discover new trends, ultimately leading to a more personalized and immersive shopping experience.

### **Enhancing Accessibility**

Eliminating the need for physical visits to stores is particularly beneficial for individuals with mobility challenges, disabilities, or health issues that make it difficult for them to visit brick-and-mortar stores. So, you make shopping more accessible for a wider range of customers.

These tools also allow customers from remote areas to access a diverse range of products and cater to many body types and sizes.

### **Gaining a Competitive Edge**

Virtual try-on provides a novel and exciting shopping experience that sets businesses apart from traditional retailers. This innovation helps retailers capture customers' attention, generate positive brand associations, and encourage repeat visits. Plus, the feature can attract a tech-savvy customer base that appreciates and values businesses that embrace new digital experiences.

## Check Out AI Integrated Virtual Try-On Demo

While there are many excellent virtual try-on options available, the best virtual try-on software ultimately depends on your specific requirements, industry, and the features you prioritize. So, you may want to assess firsthand how the software functions and discuss its capabilities with the team behind it.

Want to get a [virtual try-on demo](#)? We provide an in-browser experience that allows you to try on different models, styles, or colors of eyewear to get a feel for our AI integration:

1. Choose from two eyewear models: classic or aviator styles.
2. Explore different color options for both the glasses and frames. This allows you to see a few combinations of glass and frame colors and how they would look on your face.
3. The software will provide a visual representation of the selected glasses by overlaying them on your face in real time through a webcam.

**Virtual Try-On Case Study:** [AR-Based Web Solution for Virtual Try-on of Eyewear with Lens Scanner, AI Advisor, and Inclusivity Features](#)

Please note that this try-on demo provides a glimpse of the tech capabilities rather than showcases the full range of features and customization options available. The demo is designed to provide a brief and introductory experience so that you can get a taste of the technology and its potential applications. [Let's talk now.](#)



Where software concepts come alive™

### Business Domain

Media & Publishing

### Project Type

Data Processing

# Intetics Created a Machine Learning Algorithm That Recognizes Human Emotions To Improve Wearables for Sports Fans

## Client

The Client is a UK-based wearables development company.

## Project

Enriching the product with an emotional-response feature.

## Objective

To develop a machine learning algorithm for emotion recognition and find correlations between biosensor data and emotional events.

## Team Reinforcement

To successfully implement the feature the Client needed a team of experts to build the machine learning algorithm for emotions recognition. The Client approached Intetics with the request to fulfill the task within a strict time span.

# Challenge

The Client is a UK-based wearables development company that was launching a wearable for sports fans.

The Client decided to enrich the product with an emotional-response feature and needed a team of experts to develop a machine learning algorithm for emotion recognition.

The Client carried out research and gathered data from different biometric sensors, worn by fans during live events, and also came up with suggested emotional responses. They delegated Intetics to develop the ML algorithm and the feature.

## Quick Facts

- ✓ Valence of an emotion and the arousal level are recognized
- ✓ The model is edge-computing ready and optimized for wearables
- ✓ As a result of Intetics' research, the hardware cost was optimized

### Technologies

MATLAB, C# .NET

# Solution

## ★ 01

The Client's wearable device for sports fans proves that the recognition of emotions from the data of biosensors is possible and works. The consumers can now use the feature to share their emotional reactions to sports events.

## ★ 02

- Having biosensor data and time-coded reactions to the events, Intetics decided to apply a supervised machine learning approach when creating the algorithm.
- Before developing the algorithm, Intetics implemented a visual tool for biosensor data labeling. Using the correct labels is critical for supervising machine learning issues. In that context, labels corresponded with time intervals in which any intense emotions were expected. The biosensor data of each fan was labeled individually based on XML timecoded feeds, video recordings of games, and fans' physical reactions. Using the visual tool, an operator was able to quickly and efficiently make the labels.

## ★ 03

The preprocessing of the data was the first step of the algorithm. This included data filtering and removal of some artifacts. Along with that, each filter introduced a delay in the data, called a "group delay." This means that the output filter data was a bit shifted against the input data (i.e., slightly delayed). Each filter had its own group delay. These delays need to be considered because misaligned time data may cause low results of recognition, even if the rest of the algorithm is perfect. After all of these actions, the output of each sensor was normalized and fit the range from 0 to 1.

★ 04

The second step included extracting features and performing segmentation. Segmentation meant that all data from each sensor, processed at step one, was presented in short pieces of time, usually from 1 to 3 seconds. The feature extraction process included calculating the values for each time segment and sensor.

★ 05

The third step was about dimensionality reduction. After the first and second step, the Intetics team had a large volume of data.

★ 06

The fourth step was related to data splitting for training and testing purposes. That step required specific algorithms. The data was split into two parts. 70% of it was used for training while 30% was for testing.

★ 07

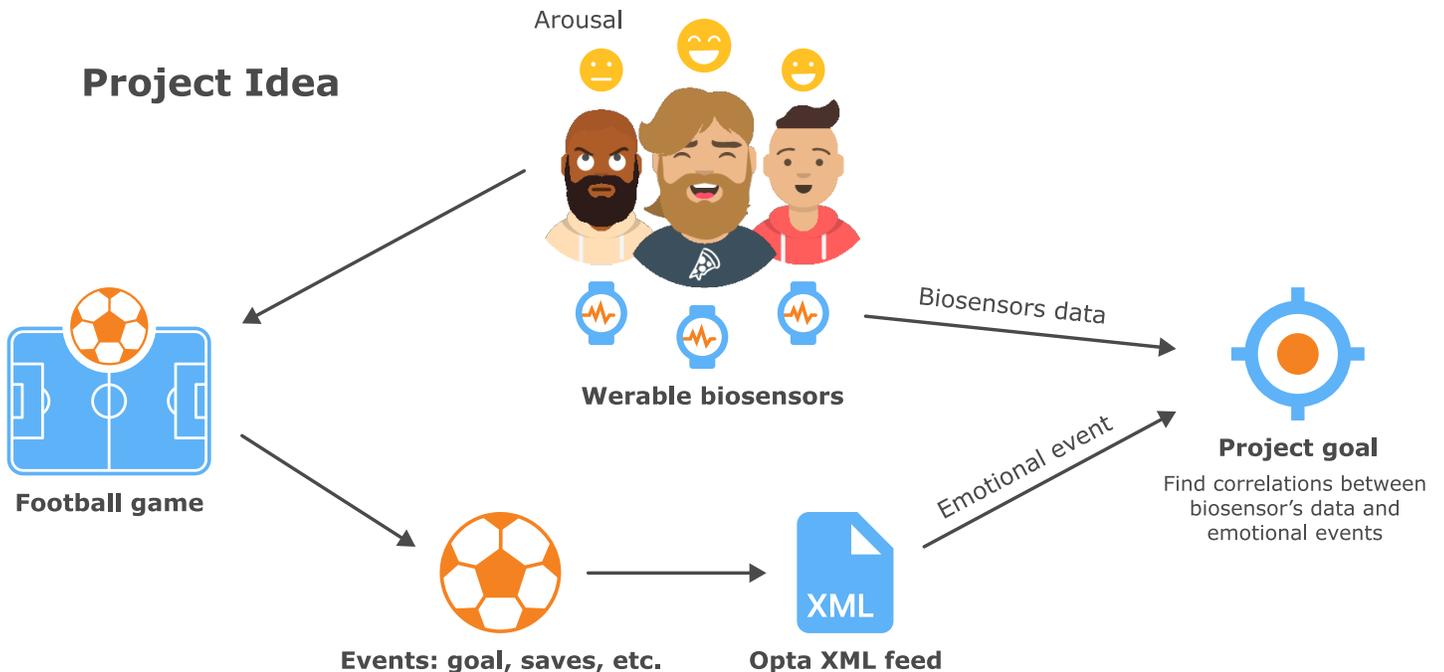
Training was the fifth step. To train the algorithm, the Intetics team used 70% of collected data and relevant labels to teach the algorithm which time segments were emotional and what type of emotion they related. Following this approach, the algorithm remembered segments that were characterized by emotions.

★ 08

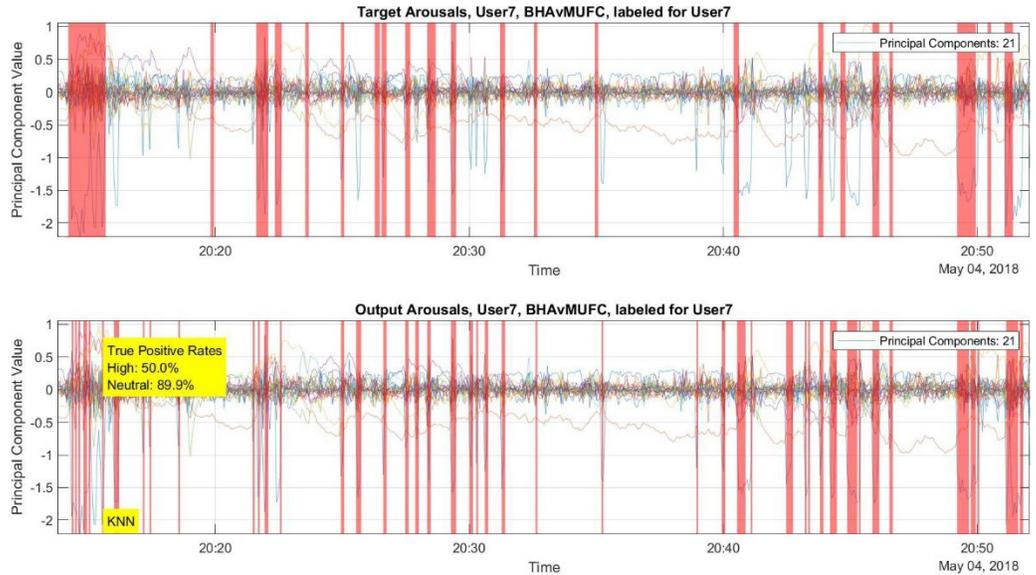
The testing of classification was the last step. The trained algorithm used the remaining 30% of data. During the testing process, the algorithm estimated each segment and made decisions. Often in the real world, algorithm training and all previous relevant steps are performed offline, before uploading firmware into the device. Classification and all relevant steps from the first one are performed in real-time on the device.

★ 09

During this research, Intetics found the most revealing metrics for emotion recognition. This allowed us to optimize the hardware cost by including only the necessary sensors.



**An example of classification results, time domain**



**Client Reference**



*Together with Intetics, we've not only developed a wearable device with the embedded emotion recognition feature but also proved that such features is possible based on biosensor data. Our work may become a significant contribution in the niche and find more application across different niches.*

**CTO**

**Benefits and Results**

- ★ The Client managed to implement the algorithm that confirmed that the recognition of emotions from the data of biosensors is possible and works.
- ★ Sports fans can now share their emotional reactions to sports events via wearables.
- ★ The algorithm allowed to add the innovative feature to the product and thus boost customer loyalty to the product.
- ★ Intetics delivered the solution in time, regardless of the short timeframe.

Chapter 7

# AI in Automotive Solutions

(#ComputerVision)



Where software concepts come alive™

### Business Domain

Parking services

### Project Type

Machine Learning Services

# Model Development for Automatic Parking Sign Recognition – 90% Accuracy Including Recognizing Unstandardized Signs

## Client

The Client delivers innovative products for the automotive and transportation industries, such as real-time parking and traffic information and solutions that facilitate autonomous vehicles' safety testing and deployment. They also provide new insights to various other industries to make better business decisions by understanding how people move throughout the day.

## Project

Building an ML pipeline for parking sign recognition to detect a sign's location and recognize the restrictions and time bounds for parking with no less than 90% accuracy, including recognizing unstandardized parking signs with texts.

The algorithms should recognize and classify the input images from mobile mapping platforms installed on the cars.

Wrapping ML model into a stand-alone web service and its integration with a customer analytics platform.

## Objective

Developing of a web service to automate the collection and entry of parking data.

## Team Reinforcement

The Client does not have Data Science experts but wanted to test how machine learning could improve and speed up data processing workflows to provide actual data updates for the biggest clients. Intetics software engineers offer the required expertise.

# Challenge

The project had several challenges: data analysis from several on-street images providers, development of an image download and pre-processing workflow, building a solution for parking sign detection and classification, extraction of text information about on-street parking from cropped images, integration of the end solution into Clients' cloud infrastructure.

The Client approached Intetics with a need for accurate detection of parking locations, restrictions and time limits. The detection was based on roadside imagery covering the area of a city. No less than 90% of the signs had to be identified correctly. Parking signs are not standardized. This makes the recognition more complicated because the process is based not on the sign in general but on the actual text on the sign. To solve this issue, object detection supported by image classification was used.

Due to the method of roadside data collection, some signs were present on several photos. That required the additional task of grouping data for one parking sign and determining the exact location. The algorithm also had to deal with poor image quality, different types of weather, light conditions, time of the day, seasons, fog, and other distortions.

## Quick Facts

- ✓ Semi-automatic data labelling
- ✓ Recognition of unstandardized parking signs with texts
- ✓ 90%+ accuracy of recognition

### Technologies

Python / Flask / Tensorflow / Keras / OpenCV / Scikit-learn / Tesseract / AWS

# Solution

## ★ 01

To identify a specific parking sign, several steps were involved: identification of an image with a sign on it, detection of the parking sign on the image, and recognition of the text within the OCR component using basic NLP. Machine learning based on the TensorFlow framework and Keras library.

## ★ 04

The next stage covered iterative development and initial training of the Machine Learning model. Here it was possible to give a precise prediction of the accuracy that could be achieved with sign recognition and time for training the model.

## ★ 02

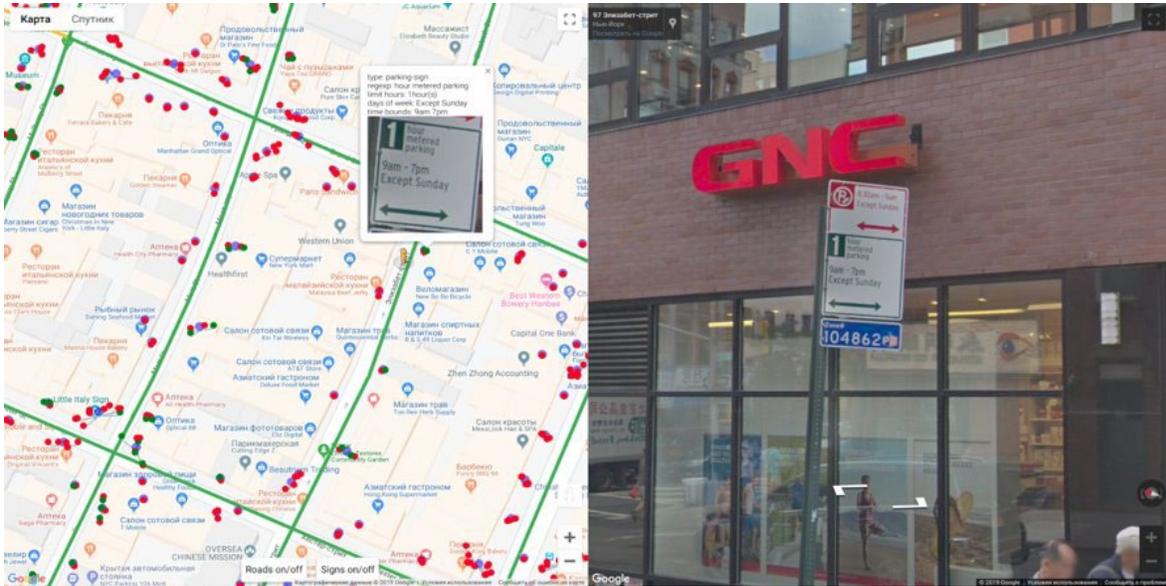
The project started with the analysis of data and sources and resulted in an estimate for the data processing phase.

## ★ 05

Within the postprocessing stage, sign location clarification and the same sign association problems were solved.

## ★ 03

The next stage included data labeling and data transformation. Semi-supervised active learning techniques were used and saved up to 70% of the time spent on manual data labeling. To eliminate errors associated with various distortions, all types were identically distributed over labelled datasets: training, development, and testing. A script for automatic data transformation was also developed during this stage to reduce the data to a single format (color, rotation, tilt, etc.)



## Client Reference



*Due to the predictable development approach, Intetics provided a detailed analysis and estimates for every step of the project and ensured all expectations would be met.*

**Client's representative**

## Benefits and Results

- ★ The algorithm was successful in identifying 85%+ of signs on the streets in the city. 90%+ of the signs were identified correctly.
- ★ All the ML and data processing algorithms were implemented in a single web application and supported with a detailed description of the model and project documentation.
- ★ The Client received a solution that automated parking sign detection and reduced the workload significantly.



Where software concepts come alive™

### Business Domain

Travel, Transportation,  
and Logistics

### Project Type

Data Processing Platform

# A Navigation Company Expands Car Parking Coverage and Automates the Processes with a New Data Processing Platform

## Client

Founded in 2005, the Client's company pioneered the practice of managing traffic by analyzing data not just from road sensors but also from vehicles. Thanks to the breakthrough approach, the Client became one of the leading providers of data and insight on how people move around the world.

## Project

Developing a Data Processing Platform that optimizes data handling and automates processes of finding a free parking spot using Machine Learning.

## Objective

The Client required a new enhanced system that could analyze a big amount of parking data in real-time and find an empty slot for the driver. The driver experience should be enhanced and improved using ML&AI technologies.

## Team Reinforcement

The Client's existing data processing team required reinforcement and new approaches to enhance the data handling. Offshore Dedicated Team® (ODT) was formed to empower the Client's team and reduce operational expenses.

# Challenge

The Client delivers innovative products for the automotive and transportation industries, such as real-time parking, traffic information, and solutions that facilitate the safe testing and deployment of autonomous vehicles.

The Client had a lot of manual processes in data processing. Many approaches were obsolete and included gaps in existing data processing capabilities of a major parking service provider.

The capacity and experience of the in-house team were limited, and they could not address database expansion and maintenance on their own, so they needed a trustworthy partner to address this task.

## Quick Facts

- ✓ 5 years of continuous cooperation
- ✓ 70% of operational processes and project KPIs have been developed by Intetics ODT
- ✓ Over 1 million parking locations have been processed

### Technologies

Python 3 / Django / Beautiful Soup / JS ( JQuery, JQuery UI) / SQL / Postgres / HTML / CSS3 / Bootstrap / HTML / CSS / Google Spreadsheets API / Google Maps API / Google Data Studio / Microsoft Power BI / Visual Studio Code / Git / Bitbucket / JIRA

# Solution

## ★ 01

The unique approach of Intetics' ODT met 100% of the Clients' requirements on data quality and processing. The productive collaboration has lasted for the past 5 years.

## ★ 02

Based on software development practices and a deep, practical understanding of the industry, the united team optimized data analysis. The solution reduced efforts on repetitive actions and let the team focus on analytical and verification tasks.

## ★ 03

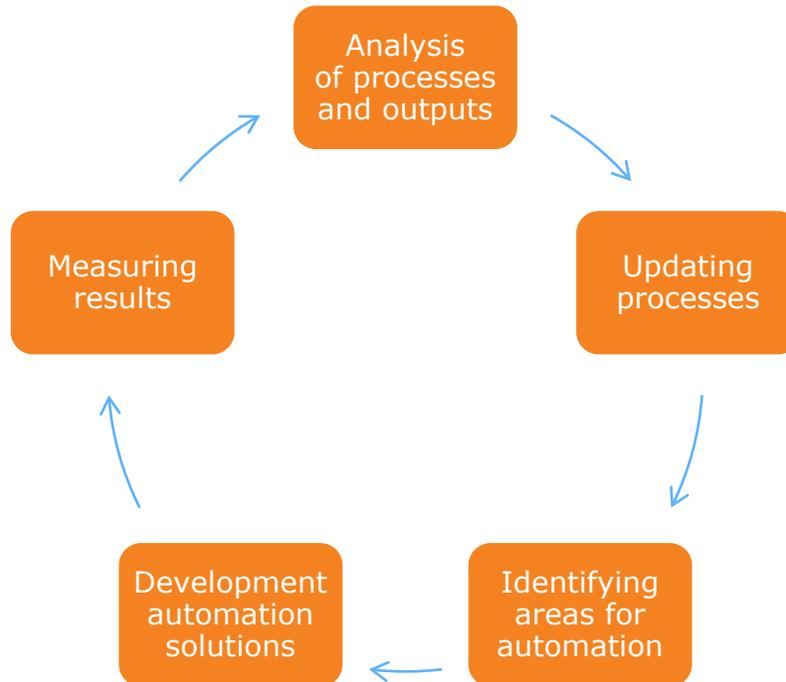
The ODT reviewed existing processes and developed missing ones. Along with this, the ODT identified areas for automation and developed software solutions to reduce repetitive actions, perform automation QA checks, and improve reporting processes.

## ★ 04

Implementation of best practices from Lean and Kanban helps the Client speed up data processing and reduce costs.

## ★ 05

Drivers can now leverage one of the most full and accurate parking coverage databases to improve their parking experience.



## Client Reference



*Our mission has always been to make parking easier, faster, and less expensive for consumers.*

**Client CEO**

## Benefits and Results

- ★ The new data processing approach helped the Client expand their parking coverage rapidly and become one of the top 5 companies in the industry.
- ★ The Intetics team accelerated the data aggregation speed and accuracy in record time, which left the Client more time for pursuing new market opportunities.
- ★ The Client was able to leverage the new data processing approach internally less than 1 year after the project started.

### Techstack:

Python 3, Django, Beautiful Soup, JS, SQL, Postgres, HTML, CSS3, Bootstrap, HTML, CSS, Google Spreadsheets API, Google Maps API, Google Data Studio, Microsoft Power BI, Visual Studio Code, Git, Bitbucket /JIRA

### Team: 20+

Project Manager, System Analyst, Team Leads, Developers. Data Processing engineers

Chapter 8

# Computer Vision for Environmental Monitoring

(#ComputerVision)



Where software concepts come alive™

### Business Domain

GIS and Geospatial solutions,  
AI

### Project Type

Web app

# A Predictive Algorithm for Upcoming Wildland Fire Conditions and Improved Current Fire Perimeter Map With 84% Predictive Accuracy for a US Tech Company

## Client

WTVIII, Inc. is an innovative leader in system integration, consulting, and software development, with 20+ years of experience helping customers streamline operations through automation.

## Project

Creating a model to predict how the fire will spread further in fire-affected areas with Computer Vision. Refactoring and enhancing a web portal that provides critical wildland fire information to public consumers.

## Objective

The Client needed to enhance interactive fire and smoke maps of current wildland fire conditions using content from Google, USGS, NIFS, as well as promote a nation-wide data exchange to enable interoperable wildland fire operations and assess the fire danger level throughout the USA. Besides, a history dataset for all reported wildland fires in the USA and 1-9 day forecasts for fire incidents were to be established.

## Team Reinforcement

The Client required a highly experienced Remote In-Sourcing® Team to develop industry-specific ML algorithms to solve the Objectives.

# Challenge

WTVIII, Inc. is an innovative leader in system integration, consulting, and software development that delivers world-class solutions to public and private clients with 95%+ Dunn and Bradstreet client satisfaction scores.

The project's technical objectives were:

- To store public data feeds with current conditions of fire and smoke spreading
- To assess fire perimeter risk
- To predict smoke conditions, intensity and direction
- To deliver website integration and component prototype.

The Client didn't have the required in-house expertise, so they looked for a reliable partner to implement the solution at reduced costs, without risk of failure, and in time.

## Quick Facts

- ✓ 84% predictive accuracy
- ✓ 30% budget savings during development
- ✓ Delivered the project in 3 months instead of 5

### Technologies

Web Server: Nginx 1.18 / Language: PHP 8 / Framework: Laravel tabase: PostgeSQL 12 / Gis extention: PostGIS 3 / CRON Jobs / TypeScripr / ReactJS / react-leaflet / NPM 8.15 / React 18.2 / Leaflet 1.8 / Python

# Solution

## ★ 01

Fire forecasts decrease negative affects on human health through smoke emissions and safety risks, as well as allow for better forest resource management and planning for wildland fire evacuations.

## ★ 02

The ML model forecasts fire and smoke spreading with an industry-leading accuracy of 84%.

## ★ 03

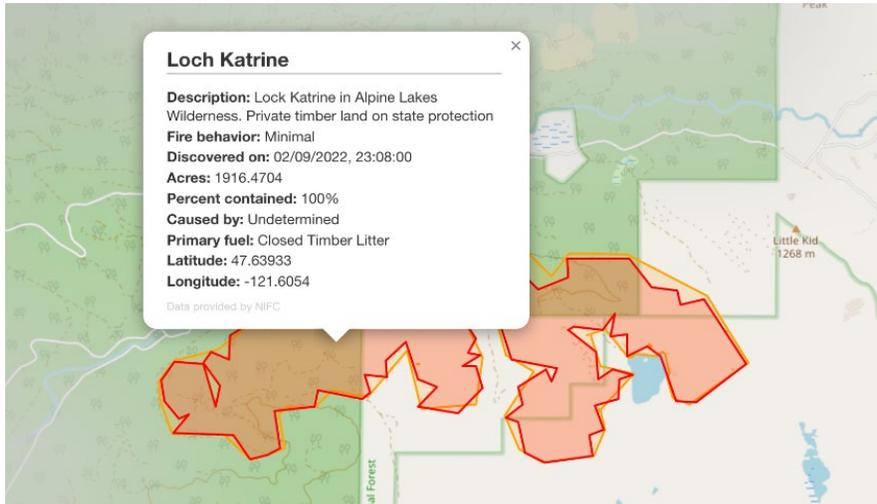
AI allows users to click anywhere on the map to get a prediction on how many days it will take to extinguish a fire, if one takes place at the chosen area. History data is also accessible.

## ★ 04

The data was collected from various sources and visualized for the end user on a map. It is presented in GeoJSON format and raster images.

## ★ 05

Delegating the task to the Remote In-Sourcing® team allowed WTVIII, Inc. to complete the project 2 month faster than required and to reduce the development costs by 30%.



## Client Reference



*We would like to highlight the professional work of the team, which not only efficiently completed the short-term initial tasks before the specified deadline but also expanded the project by proactivity, ideas, self-organization, and predictions. Throughout the project journey, they proposed new solutions, which were successfully implemented in the deliverables. It allows us to form our business plan, and the work on the project continues.*

## Benefits and Results

- ★ The out-of-the-box solutions with thought-through technical details allowed for improved fire and smoke maps with enhanced predictive algorithm.
- ★ The Client successfully implements ready-made project solutions on their side and clearly understands what needs the product should cover.
- ★ The AI/ML models are being enhanced by the best practices within the domain and are becoming more sophisticated every day, facing the most creative challenges.
- ★ 80% of deliverables were ready in 3 months instead of the projected 5 months. The Remote In-Sourcing® team proposed several ways to continue developing the Client's business, so the cooperation is still ongoing.

### Techstack:

Web Server: Nginx 1.18, Language: PHP 8,  
Framework: Laravel tabase: PostgreSQL 12,  
Gis extention: PostGIS 3, CRON Jobs,  
TypeScripr, ReactJS, react-leaflet, NPM  
8.15, React 18.2, Leaflet 1.8, Python

### Team: 5

Project Manager,  
ML engineer,  
Frontend engineer,  
Backend engineer,  
QA

# intetics

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## Business Domain

GIS and Geospatial,  
Environmental

## Project Type

CLI tool, shared library

# Automated Drone Image Processing Reduced Manual Work by 70% for a US-based Environmental Monitoring Company

## Client

The Client is a tech advanced data collection and monitoring company specializing in GIS database solutions for large-scale projects. They offer geospatial development, biological monitoring, environmental studies, and restoration plan development.

## Project

Developing an advanced tool to automatically extract key features like tanks, separators, buildings, and containment structures from drone images.

## Objective

The Client requires a strategic and technical solution to streamline and cut costs in processing drone imagery for construction site monitoring. This involves automating feature extraction from environmental data to boost efficiency.

## Team Reinforcement

The Client lacked machine learning expertise necessary for implementing the automation tool within their data processing workflows. Utilizing the Time & Material (TM) model, Intetics developed a customized solution from scratch applying the unique ML expertise in the geospatial field and tailoring the development approaches to seamlessly integrate with the Client's data.

# Challenge

Developing a powerful automated solution for extracting features requires seamless integration with Windows and ArcGIS Pro. It should offer a user-friendly process for extracting features into the Client's data model, using shapefiles to streamline data transformation and loading.

The Client was looking to automate their processing workflows to improve data accuracy and consistency while reducing human errors associated with manual processing.

The Client sought a seasoned machine learning solution provider. Intetics conducted a thorough analysis of the Client's system, offering a strategic overview of development. Leveraging expertise in ML techniques, Intetics navigated complexities and crafted innovative solutions to drive the project forward.

## Quick Facts

- ✓ 95% of detection accuracy
- ✓ The automated processing resulted in a 35% cost saving compared to manual processing
- ✓ Ongoing cooperation to extending the functionality of the developed solution

### Technologies

Python / PyTorch / Rasterio / OpenCV / GeoPandas / ONNX

# Solution

## ★ 01

The ML-powered solution enabled the Client to automate processing tasks, conduct advanced environmental analysis, and enhance data security while mitigating compliance risks.

## ★ 02

Robust feature detection, simple integration into proprietary software, possibility of standalone execution, flexible configuration, easy tuning pipeline, modern technologies and frameworks.

## ★ 03

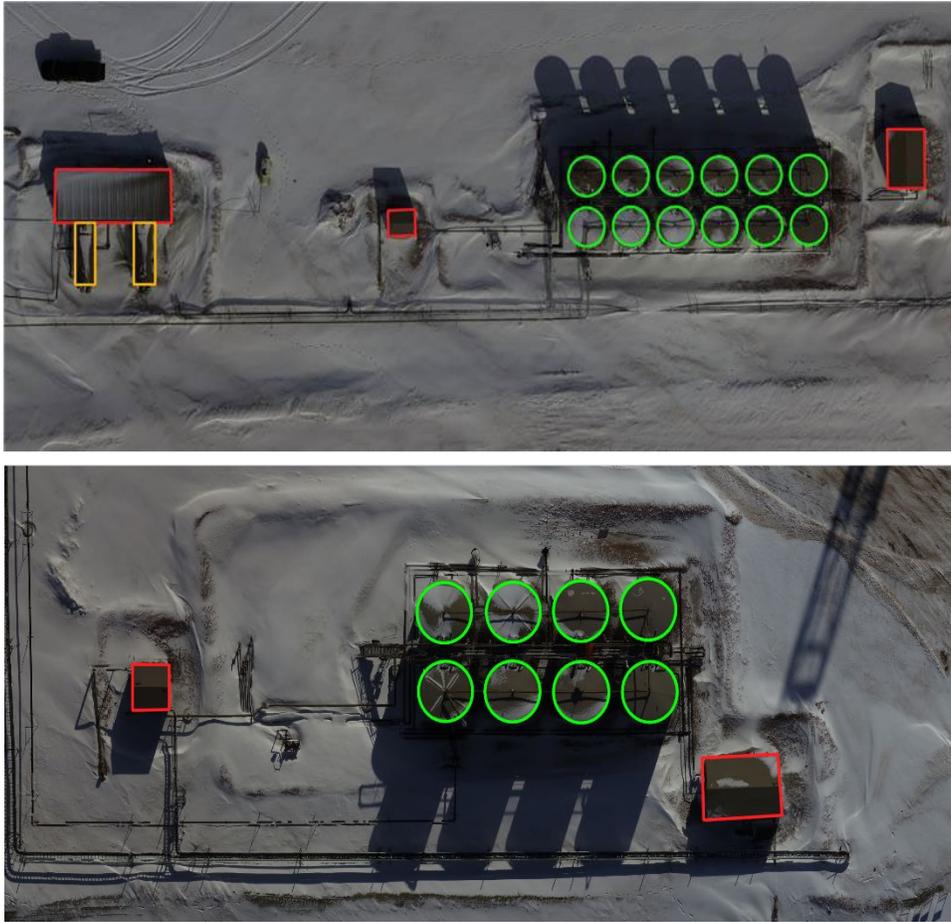
Designed to adapt to evolving environmental data and challenges, the solution utilizes advanced machine learning algorithms to offer actionable insights, analytics, and monitoring.

## ★ 04

An innovative object detection solution, utilizing deep learning with PyTorch, ONNX, GeoPandas, and Open3D, achieved high-quality results with minimal resources, ideal for precision-critical tasks.

## ★ 05

The project succeeded by merging Point Clouds and Rasterized Orthophotos. Converting 3D point cloud data into a 2D heightmap via rasterization combined the strengths of both data types, resulting in a more detailed and precise environmental representation for enhanced object detection.



## Benefits and Results

- ★ The Client received a fully customized solution developed from scratch, utilizing state-of-the-art data science technologies and techniques.
- ★ By implementing the solution, manual work is decreased by 70%, eliminating a substantial number of human errors and cutting significant costs on operational staff.
- ★ The performance of the developed algorithms exceeds the assumed accuracy percentage, reaching 95%.
- ★ The first feasible results ready to be implemented into production have been reached within 2 months of cooperation between the Client and Intetics.

Chapter 9

# AI in Manufacturing and Maintenance (#PredictiveAnalytics)

# intetics

Where software concepts come alive™

## Business Domain

Automotive and Manufacturing

## Project Type

Predictive Maintenance /  
Coffee Equipment

# Swiss Coffee Equipment Manufacturer Reduces the Operational Costs by 17% with AI-Based Predictive Maintenance

## Client

The Client is a Swiss coffee grinder manufacturer. They introduced an Innovation Department to implement predictive maintenance for coffee equipment. The equipment serves cafes globally, ranging from small to large establishments.

## Project

Downtime and proactive repair forecasting enabled with AI-based Predictive Maintenance.

## Objective

To develop a solution to absorb service-relevant information, including historical data, and predict potential system failures, downtime, or equipment breakages. The complementary goal is to efficiently manage maintenance personnel and spare parts inventory, ensuring abstemious use of resources.

## Team Reinforcement

The project involved developing the proof of concept (PoC) from scratch with an expert team comprising:

- Project Management Team (PM+BA)
- Lead Architect
- Embedded Developers (C/C++) for data collection from coffee machines
- AI Engineers for machine learning models
- AWS Dev & ML Ops

## Challenge

Thousands of customers are using the Client's coffee machines and grinders, leading to significant spending on equipment maintenance. To reduce dependency on the spare parts supply chain, differentiate from competitors, and better serve their customers, the Client decided to introduce a smart maintenance tool.

Create a platform with smart notifications on potential system downtime and maintenance accessible from web & mobile devices.

The Client, lacking an in-house R&D department, opted to assemble a project team with the help of one of the many explored vendors. The challenge extended beyond building the predictive maintenance service to developing a system for data analysis and compilation of industry reports for different business entities.

## Quick Facts

- ✓ Validated feasibility for key enterprise clients
- ✓ 86% of ML model accuracy
- ✓ Over 17% reduction in maintenance costs

### Technologies

**Frontend:** React.js (web) / React Native (mobile)

**Backend:** C/C++ (embedded) / PHP (Core) + Python (AI/ML) / PostgreSQL

**Dev Ops:** Jenkins + Docker Composer

**Cloud/ML Ops:** Amazon Web Services

## Solution

### ★ 01

A platform with smart notifications on potential system downtime and maintenance accessible from web & mobile devices.

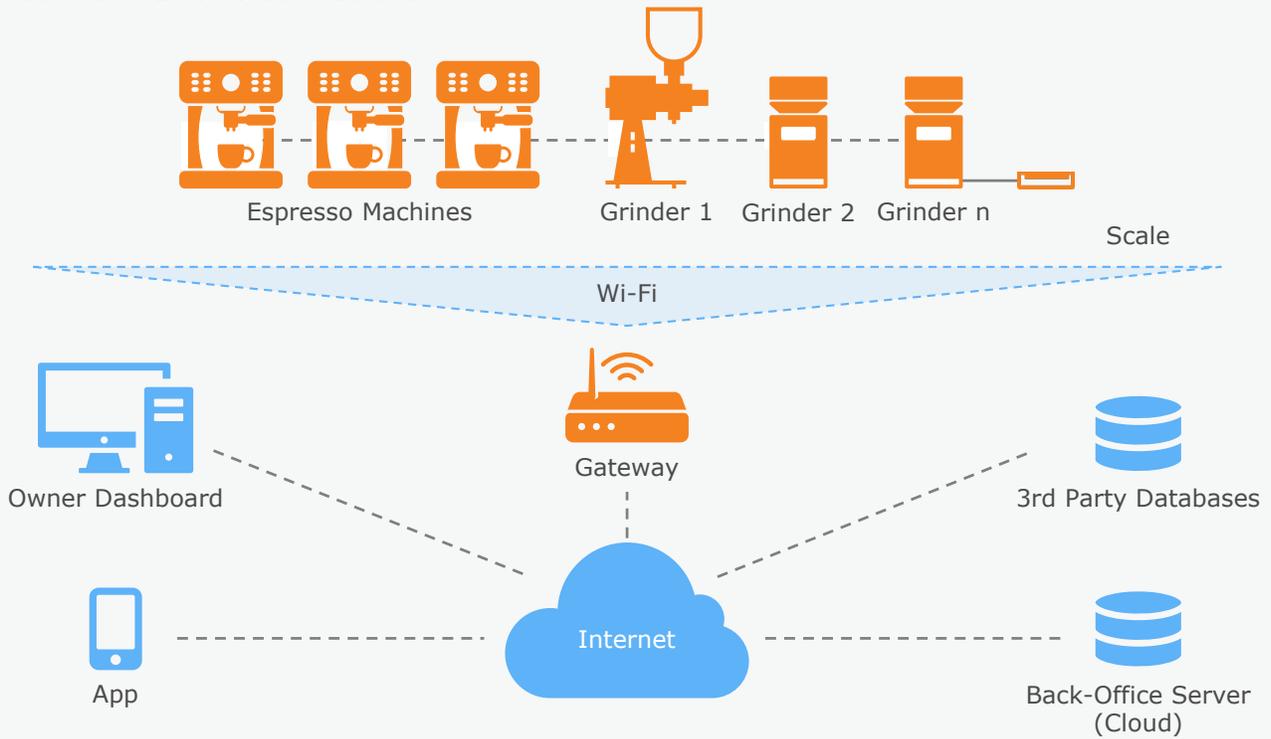
### ★ 02

The platform accurately predicts downtime or system failure with an 86% accuracy rate on the training dataset. The Client has opted to continue the work on the AI model due to trade secrets.

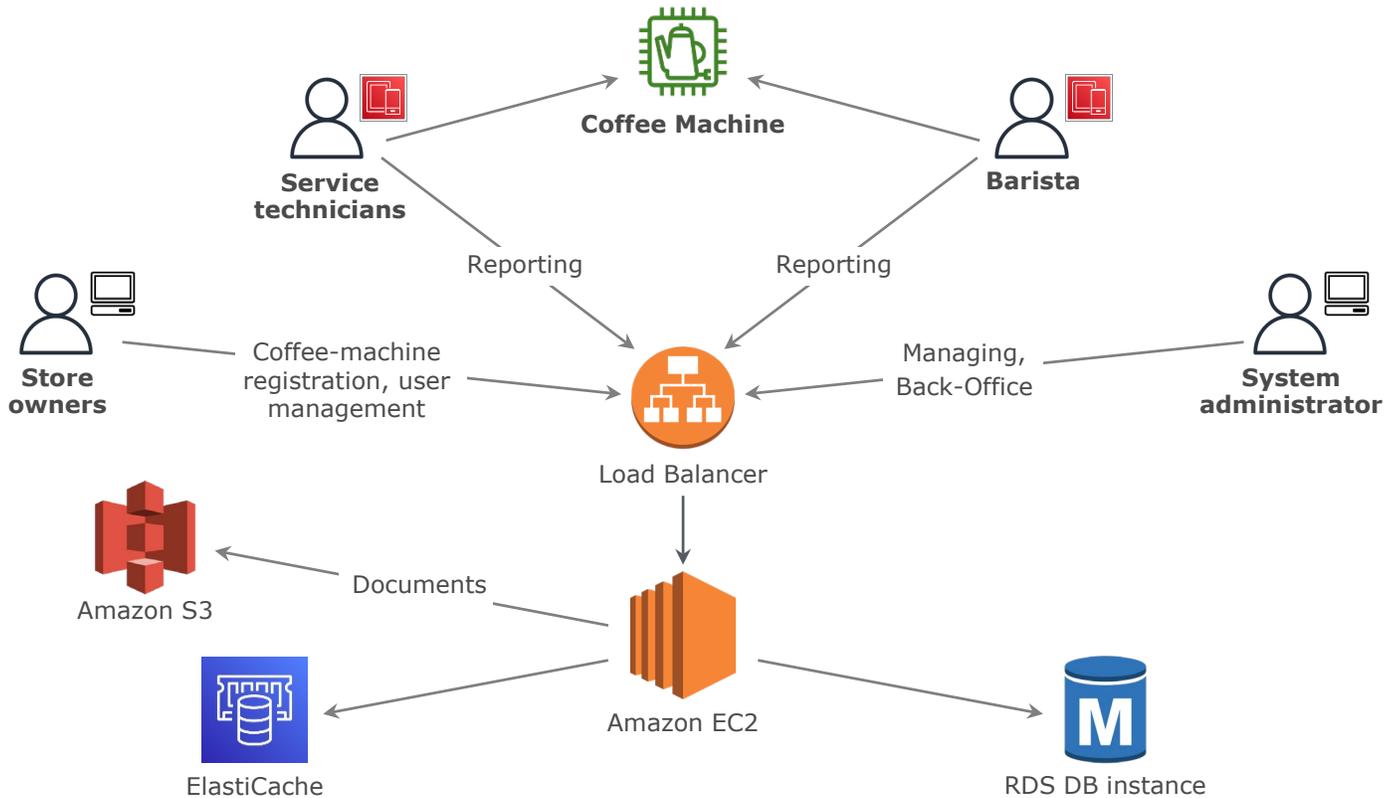
### ★ 03

Over two years of successful collaboration, the delivered product has transformed into a service that assists businesses in establishing customer trust.

## General Schema



## High-Level Architecture





## Client Reference



*With the help of Intetics, people are experiencing the best coffee flavor without interruption. Thank you for your professionalism and dedication to the project.*

### Client's team

## Benefits and Results

- ★ During 2 years of successful cooperation, the delivered product became a service that helps businesses build customer trust.
- ★ The platform predicts downtime or system failure on the training dataset with 86% accuracy. The Client decided to continue the work on the AI model internally because of trade secrets.
- ★ The initial version of the platform was released in 6 months.
- ★ After the release of the initial version, the Client decided to continue developing the extensive dashboards and reporting functionality.

### Techstack:

Frontend: React.js (web), React Native (mobile)  
Backend: C/C++ (embedded), PHP (Core) + Python (AI/ML), PostgreSQL  
Dev Ops: Jenkins + Docker Composer  
Cloud/ML Ops: Amazon Web Services

### Team: 12

Project Manager, System Analyst (BA), UI/UX designers, Lead Architect, 2 frontend developers, 2 backend developers, 1 mobile developer, 2 QAs, 1 Dev Ops/ML Ops

## Conclusion

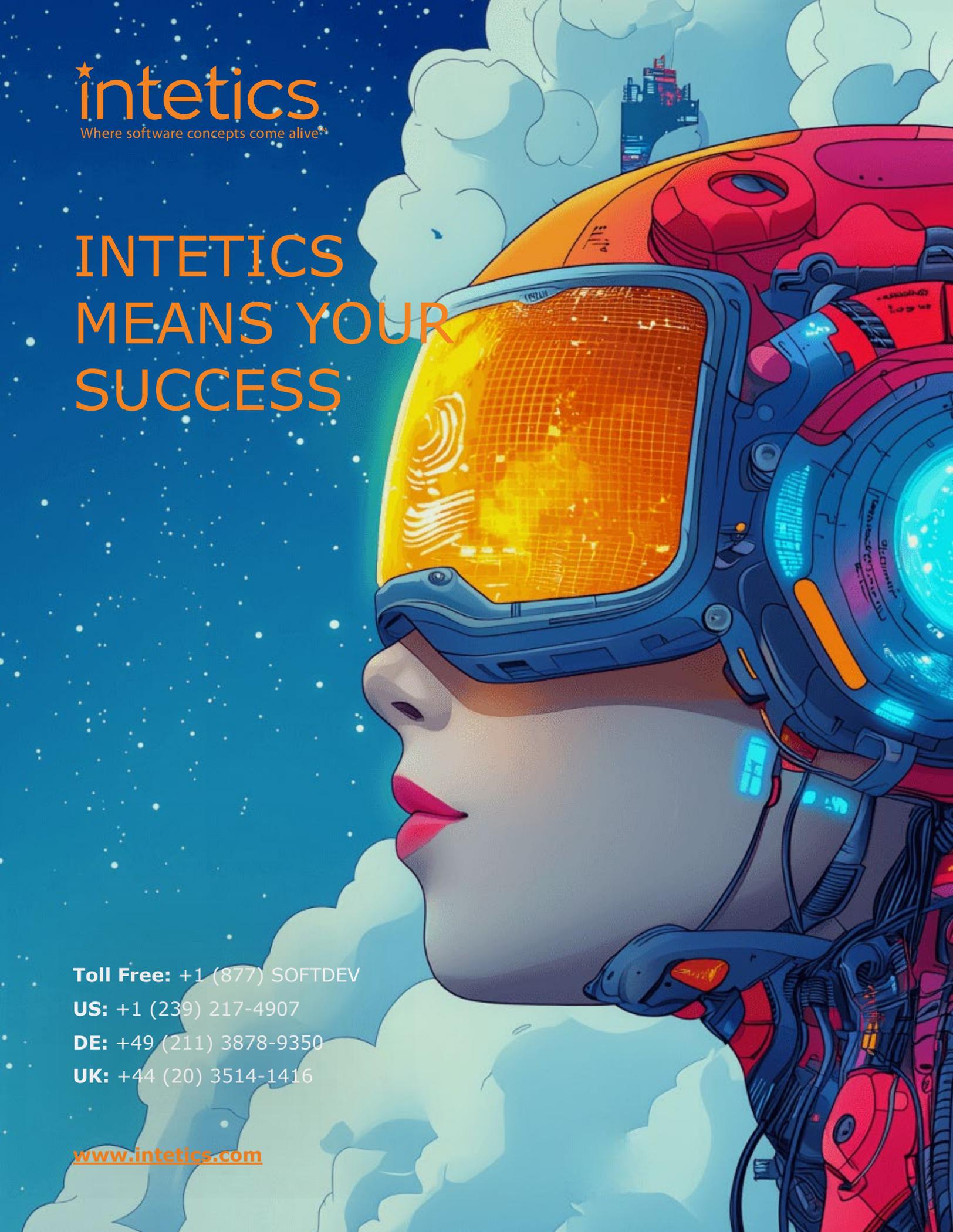
As we conclude this exploration into AI's transformative role, it's clear that businesses ready to adopt AI stand at the forefront of a new era. AI has the potential to revolutionize daily operations, enhance decision-making, and open doors to innovation across multiple industries. Companies that are agile enough to integrate AI technologies—from conversational AI to machine learning—will not only improve efficiency but also set themselves apart in a competitive market.

Over the past few years, most companies have experimented with chatbots and conversational AI. However, they now realize that to scale up effectively, they need a trusted partner with deep expertise in conversational and generative AI technologies.

We hope this eBook has not only provided you with insights but also sparked new ideas on how AI can solve the unique challenges your organization faces. The future of enterprise technology is already here, and those who embrace it today will shape the world of tomorrow.

At Intetics, our dedication to innovation is showcased through our tailored software development approach, empowering businesses to overcome complex challenges with intelligent, customized solutions. Our ability to stay ahead of technology trends while delivering high-impact services solidifies our role as a forward-thinking, innovative partner. [Join us](#), and together, let's shape the future with AI-driven solutions.





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