

A Guide to Natural Language Processing

A #ThinkBeyond Best Practice Series

PHOTON®

©Copyright 2023 Photon Interactive UK Limited. All Rights Reserved.



Table of contents

1 Executive summary

2 Overview

3 What is Natural Language Processing?

4 How does Natural Language Processing work?

5 Real-world business applications of NLP

6 The adoption of chatbots

7 NLP components and platform applications

8 NLP: Integration architecture

9 How Photon helps Fortune 500 brands leverage intelligent assistants

10 Conclusion

©Copyright 2023 Photon Interactive UK Limited. All Rights Reserved.

Executive summary

Natural (human) language is astonishingly vast, diverse, and complex. There are hundreds of languages and dialects, and each language has its own set of syntax rules, grammar, and slangs. The written word has its own anomalies like misspellings, abbreviations, etc. and when we speak, we have di˜erent accents and frequently use words from other languages. This high level of ambiguity can not only be resolved but utilized to boost a business' decision-making ability by applying Natural Language Processing (NLP).

NLP provides an algorithmic or numeric structure to text or voice-based data for functionalities like speech recognition, text analysis, and machine translation. It is almost impossible for machines to understand the context behind human language, but by harnessing NLP, businesses can successfully gather, process, and imitate human speech to give human-machine interactions a personalized feel.

This guide provides a detailed view of the advancements in NLP technology and the best practices to improve an organization's decision-making ability. It explains the business applications of NLP, such as chatbots and voice assistants, and their business benefits across various industries—eCommerce, banking, and healthcare, among others. The guide further reveals our approach to implementing text and voice-based digital solutions for global Fortune 500 brands.

©Copyright 2023 Photon Interactive UK Limited. All Rights Reserved.

Overview

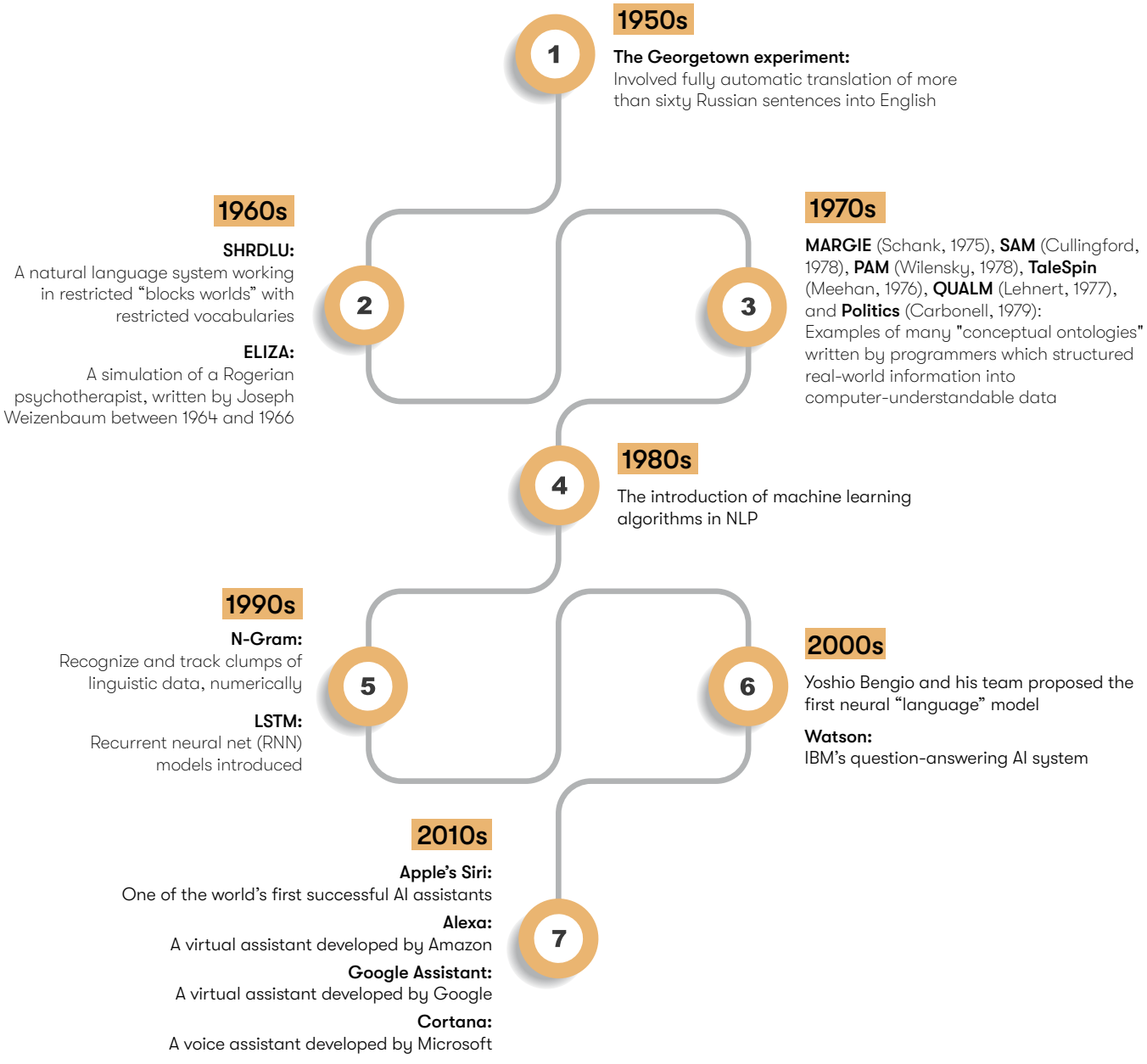
NLP is gaining a lot of focus from companies due to its rapid evolution and growing use cases. Research around deep learning, machine translation, language processing, and conversion systems has led to the development of many useful business applications. Companies across industries such as retail, finance, healthcare, and education are leveraging NLP techniques to create valuable applications that enable cognitive digital experiences, enhance the buying journey, provide instant customer service, and more.

The ultimate goal of NLP is to improve human-machine interactions to such an extent that talking to a voice-based tool becomes as convenient and intimate as talking to a real person. It is a fairly possible goal considering the ability of NLP to analyze text and voice-based unstructured data to make it meaningful to machines. A study predicted that the quantity of analyzed data by cognitive systems would grow to 1.4 ZB by 2025, impacting industries around the globe^ .



A historical perspective of **NLP**

The history of NLP can be traced back to the 1950s when Alan Turing published an article titled "Intelligence" which proposed the Turing test as a criterion of intelligence. NLP has come a long way since its nascent stages and has found numerous applications in various fields. Here is a decade-wise breakdown of NLP technology progression:



Today, the adoption and usage of voice-based solutions are one of the topmost priorities for digitally-driven companies to deliver convenient, in-the-moment experiences that connected customers demand.

©Copyright 2023 Photon Interactive UK Limited. All Rights Reserved.

What is **Natural Language Processing?**

NLP, also known as computational linguistics, is a field of artificial intelligence and linguistics that deals with the understanding, processing, and generating of natural (human) language by machines.

The subcategories of NLP are:



Natural Language Generation (NLG)

which deals with a machine's ability to create communication tools on its own



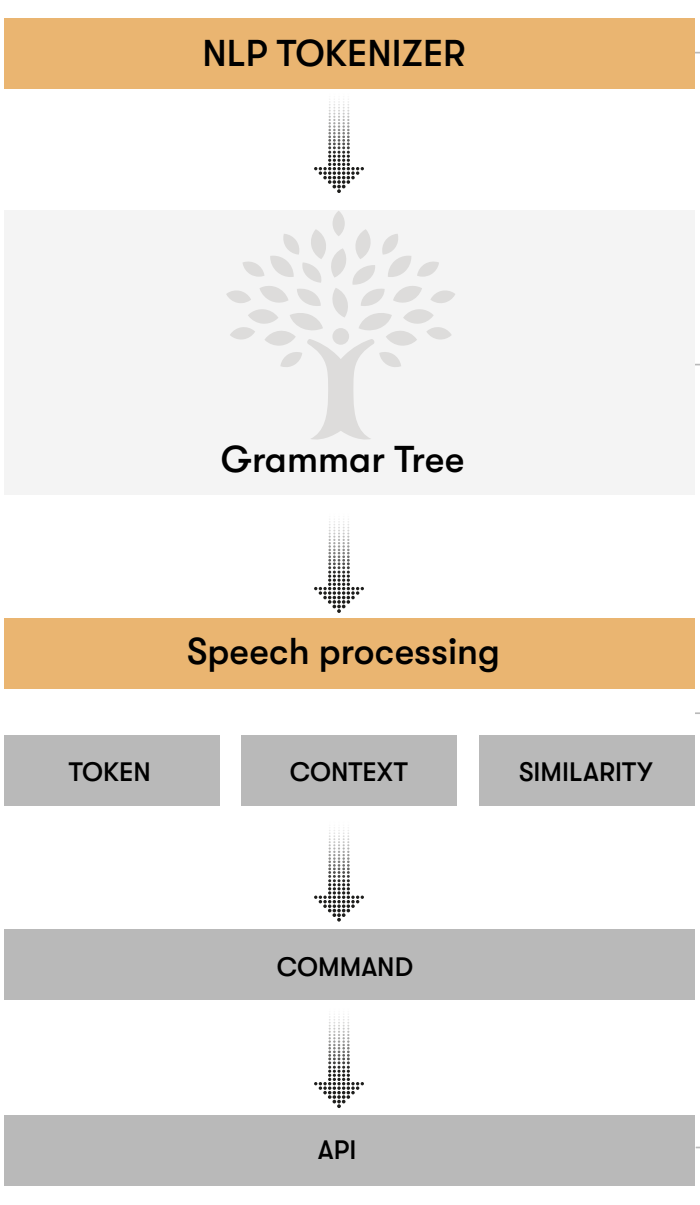
Natural Language Understanding (NLU)

which deals with a machine's ability to understand anomalies in a natural language like slangs, mispronunciations, misspellings, etc.

©Copyright 2023 Photon Interactive UK Limited. All Rights Reserved.

How does **Natural Language Processing work?**

The NLP process breaks down language input into smaller, elemental pieces known as tokens and builds a relationship between them. When put together, these pieces create meaning for machines. The following framework represents the underlying tasks that are often used in higher-level NLP capabilities.



A text from a user entered either throught speech or text, chatbot or search box

The text is passed into a grammar tree with a set of tokens

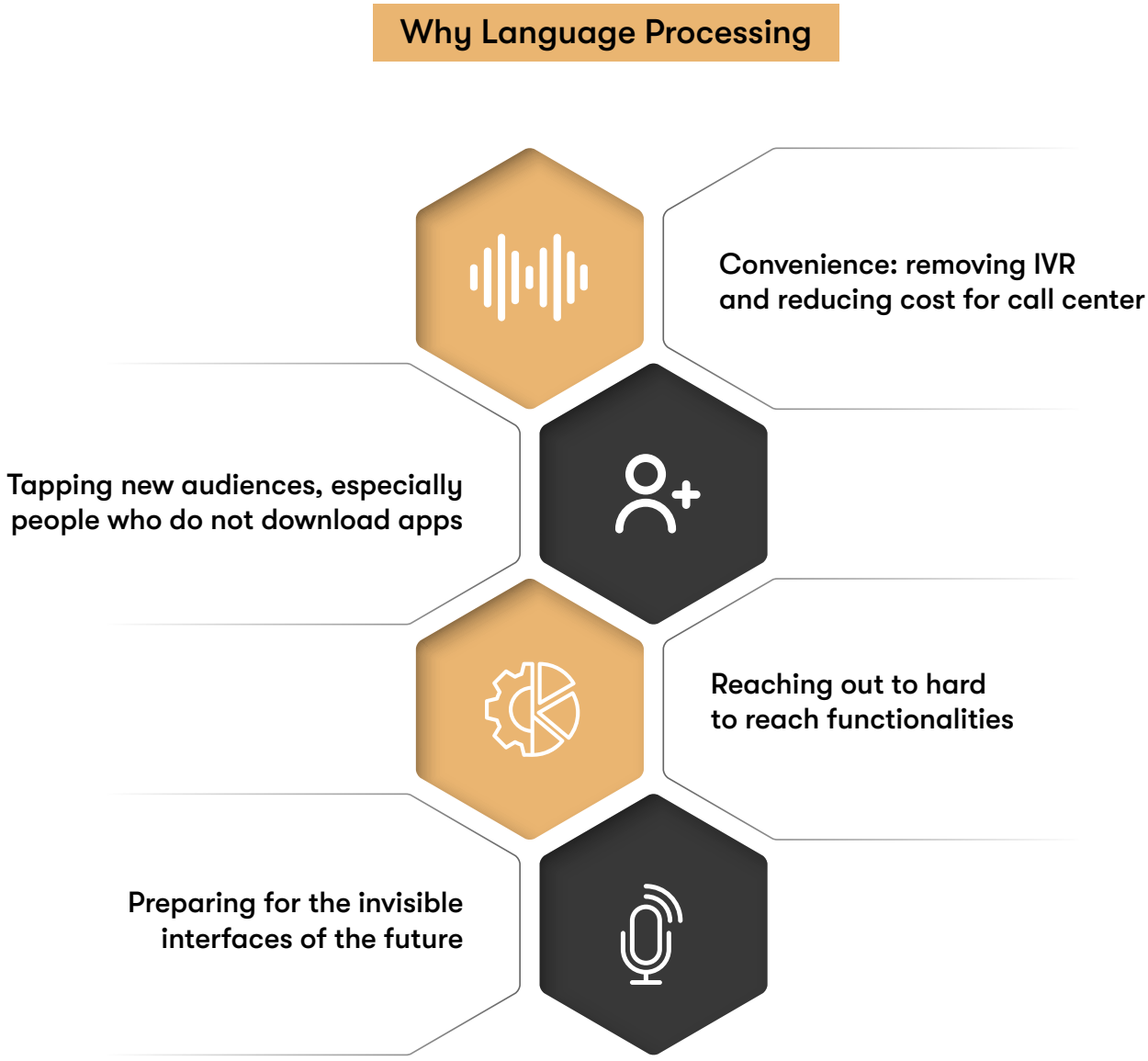
Grammer tree is analyzed for context and meaning based on other similar patterns in the past

The command is finally processed through API and the results are returned to the requesting client

©Copyright 2023 Photon Interactive UK Limited. All Rights Reserved.

The importance of NLP

It is of paramount importance for businesses to understand and utilize the amount of unstructured data—such as text and voice-based data—being generated every day. NLP helps businesses automate the tasks of reading text or hearing speech, interpreting it, analyzing the sentiment, and generating appropriate responses. Machines are far more e¸ cien t than humans in these tasks as they analyze language-based data much faster, more consistently, and without any bias or fatigue.



©Copyright 2023 Photon Interactive UK Limited. All Rights Reserved.

Real-world **business applications of NLP**



Enhance customer experience with virtual assistants:

Chatbots and voice assistants are dramatically improving the customer experience. Consumers can avoid long wait times with self-service digital solutions powered by these assistants. Those that combine virtual and human support can quickly transfer machine-led conversations to a human to better resolve queries. After Coca-Cola integrated virtual assistance software with its customer service department, it was reported that the virtual assistant handled 30,000 conversations a month successfully.



Gather customer insight from unstructured data:

Knowing and understanding customers is crucial to developing a successful business strategy. Insight on customer trends is often hidden inside social media conversations, emails, text messages, phone calls, images, articles, and reports. NLP helps businesses understand this information e, cien tly at scale. For example, processing the social media content of customers can help gain insights on their behavior, interests, and preferences—thereby helping businesses improve decision-making.

©Copyright 2023 Photon Interactive UK Limited. All Rights Reserved.

Enable sentiment analysis to address customer needs:

Brand reputation monitoring helps businesses discover what is being said about their products, services, and the brand in general on various sources. Companies can leverage sentiment analysis as an NLP application to perform text and voice data analysis and understand the emotion behind written, spoken, or visual content.

An excellent example of how to leverage sentiment analysis for brand building is KFC. To promote its products, the company launched a marketing campaign that used memes and pop culture references. This approach naturally attracted a lot of attention and engagement in their content. KFC combined sentiment analysis in social networks monitoring and campaign performance monitoring with aspect-based sentiment analysis and topic mining to create new ideas and further develop the campaign.



© Copyright 2023 Emotion Intelligence UK Limited. All Rights Reserved.

"Natural language processing, coupled with machine learning and cognitive platforms, is radically changing the frequency and immediacy of user data processing—simplifying the strategic business decision-making process."



Mukund Balasubramanian
CTO, Co-Founder, Photon

Industry-specific applications of NLP

eCommerce



- Semantic-based search for understanding shoppers' intent and delivering relevant results even when shoppers use their own unique search queries.
- NLP helps e-retailers understand consumer shopping habits and predict product demand by highlighting keywords that are part of consumer interactions. This helps them deliver targeted marketing messages.
- Smart product recommendations for facilitating customer purchases.
- Digital assistants are being used by consumers to accomplish many tasks in the buying journey—including product research, price comparison, cart addition, payment, and more.

©Copyright 2023 Photon Interactive UK Limited. All Rights Reserved.

Healthcare



- Speech recognition allows healthcare professionals to transcribe notes for useful Electronic Health Record (EHR) data entry.
- NLP-driven computer-assisted coding (CAC) provides the enabling technology responsible for automatically reading clinical documentation to identify diagnoses and procedures and then recommending codes to be assigned to clinical cases
- Leverage NLP and machine learning to identify patients for clinical trials.
- Make better healthcare decisions by improving methods of surveillance, checking symptoms, and diagnosis.

Banking & FinServ



- Intelligent document search by deriving relevant information from large data sets.
- Improve customer experiences with conversational agents that can correctly understand and process banking requests
- Investment analysis by tracking patterns on how customers might spend based on their transaction history.

Travel & hospitality



- Use voice-controlled smart hubs in hotel rooms to help guests adjust their room features like heating, lighting, air conditioning, etc.
- NLP-driven passenger information systems provide real-time transport information to ensure up-to-date travel schedules.
- Text or voice-based assistants for general customer service purposes like scheduling wake-up calls and making room service orders.

©Copyright 2023 Photon Interactive UK Limited. All Rights Reserved.

The adoption of **chatbots**

Chatbots with self-learning abilities have revolutionized the customer service industry. They can now interact with humans in a more natural manner as the technology's accuracy and sophistication continue to grow with further developments. Gartner predicts that 70% of customer interactions will involve technology such as machine learning applications, chatbots, and mobile messaging by 2022.˝

Chatbots deliver on convenience—one of the foundational pillars of customer experience. They let users decide when they want to interact and deliver on their needs in the moment. Chatbots increase the engagement capacity of businesses by not only addressing customer queries but also integrating data to analyze behavior and personalize the interactions. There are immediate cost benefits as well. It is estimated that chatbots will drive savings of more than $8 billion per annum in 2022 across retail, eCommerce, banking, and healthcare. ˙

The major focus areas for chatbots:



Customer service:

Resolving customer queries without the intervention of a human agent, and in necessary cases, escalating the issue to a human immediately.



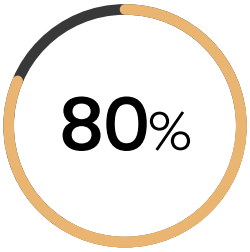
Marketing:

Supporting content-driven marketing by o˜ ering personalized recommendations around possible interest areas.

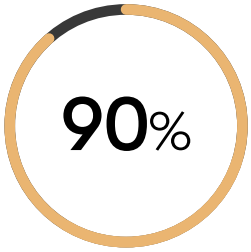


Sales:

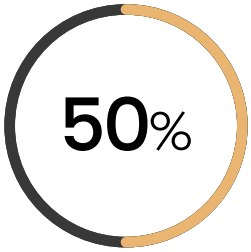
Assisting customers in choosing products or services either through variables being given or historical data.



of core businesses would deploy state-of-the-art chatbots by the end of 2020.[4]



of businesses report faster complaint resolution through the use of bots.[5]



of enterprises will spend more on chatbots than mobile app development by 2021.[6]

"Natural Language Processing e, cien tly bridges the gap between human-machine interactions and is proving to be a crucial focus area for businesses that want to track the constantly changing behaviors of connected consumers and improve decision-making."



Muhamad Daud
Executive Vice President, Engineering, Photon



NLP components and platform applications

Components



Channels

Represent the user's first interaction points with the NLP engine. Some of them provide NLU capabilities, while others simply act as a router to the core NLP platform.



NLP Platform

It is the core language processing platform. The main function of an NLP platform is to understand natural language through machine learning and map it to concrete API and its parameters.



Microservices API

The backbone of any digital property representing granular functionalities of the business presented in a standardized interface and protocol.

Platform applications



Chatbots

Chatbot applications within the app or through other messaging applications



Intelligent assistants

The implementation of intelligent assistants such as Siri or Alexa



Contextual search

Process of asking a specific question and getting relevant results through Knowledge Base Integration

© Copyright 2022 UK Photon Interactive Limited.

NLP: **Integration architecture**

Common across platforms

Authentication and user association

- Most skills are auto-authenticated with a single user
- User association and token management are done through a mobile app interface

Session management services

- Session lifecycle is important not just from a security perspective but also from a resource utilization perspective since many of these devices are resource-limited

Speech synthesis services

- To provide both pre-recorded and custom content using Speech Synthesis Markup language and its ability to "speak back" to the customer

Risk management and security

- This opens up an entirely new set of risks in terms of impersonation and hacking; therefore, we strongly recommend enhanced risk management and security services to address this
- As of now, there is no "biometric" equivalent. But in the future, we believe this will evolve

Analytics services

- Finally, there are few, if any, analytics SDKs for these interfaces, so we work actively with each customer to understand events, lifecycle, and the expectation of analytics and reporting capability



© Copyright 2022 UK Photon Interactive Limited.

Partially common

Skill registration

- A skill on Amazon Echo is registered and made available through the skills catalog
- Not as mature as the App Store, but will evolve as the number of skills increase

Launch services

- When a request comes to add a skill, there is a life cycle of launching the skill and is typically handled as lambda functions
- Classical request-response characteristics are still supported

Natural language understanding services

- Provided by each of the SDKs, so there is no need to build your own

Verification services

- Account/Login takeover
- Application-specific DDoS
- Content scraping
- Vulnerability exploitation
- OWASP threat list

Intents

- These are the crux of each interaction with a skill—specific requests should be gleaned from the input based on a natural language understanding sequence



©Copyright 2023 Photon Interactive UK Limited. All Rights Reserved.

How Photon helps Fortune 500 brands **leverage intelligent assistants**

Client:

A Fortune 100 global provider of insurance, annuities, and employee benefit programs.

Customer need:

The company wanted to identify opportunities for integrating chatbots and intelligent assistants into their digital ecosystem. They envisioned providing its users with features that would enhance the user experience and help increase conversions. The company wanted to improve the ease of transactions while providing all-inclusive information regarding the product, account, and support.

Photon's involvement:

Photon helped the company to come up with a blueprint architecture along with the implementation to integrate chatbots and NLP. Photon also helped to enable customer service through other channels.

- Photon worked on designing "conversational" interfaces—the front end of chatbots, intelligent assistants, and contextual search
- Developed the interface based on implicit launchers (intents and actions) and not on explicit launchers and actions
- Worked on designing a search engine interface as a record-keeping system rather than a form-based UI
- Enabled services like paying bills on an Amazon Echo/Siri/Cortana/Google through an integration architecture, including components like Natural Language Understanding Services, Verification Services, Intents, etc



© Copyright 2022 UK Photon Interactive Limited.



Client:

A Fortune 500 apparel and home furnishings retailer

The Requirement:

The company wanted to leverage NLP technology to create a best-in-class call center operation that would enhance the customer experience and reduce the overall cost of ownership. The retailer sought Photon's help for thought leadership, domain expertise, and best practices for an omnichannel call center.

Photon's involvement:

Photon was involved in designing the entire blueprint and workflow of the new contact center for the customers.

- Photon provided recommendations on the required framework/capabilities and a phased implementation guideline for this transformational journey
- Demonstrated various user personas, user journeys, and the flow of communication control
- Performed exhaustive analysis and research for identifying and managing challenges in third-party integrations with Amazon Echo, chatbots, etc.
- Presented an intuitive and seamless UI experience across di˜erent touchpoints to enhance the usability and customer experience

©Copyright 2023 Photon Interactive UK Limited. All Rights Reserved.

Conclusion

NLP is among the go-to strategies for not only better understanding your customers but creating and expanding an ecosystem of smart applications that will become an integral part of a user's life. Today's virtual assistants are designed to be omnipresent objects which can understand user commands and respond appropriately. With various possibilities and use cases for businesses—such as sentiment analysis, neural machine translation, market intelligence, and smart search—every industry will witness greater adoption and implementation of NLP tools.

Photon helps companies create new intelligent capabilities and standards of digital experiences by using NLP as well as other forward-looking technologies such as Internet-of-Things, big data analytics, cloud computing, APIs and microservices, and Robotic Process Automation. With a powerful network of business partners and experienced engineers and designers onboard, we help Fortune 500 brands across industries build best-in-class digital solutions to deliver engaging, hyper-personalized customer experiences and foster growth.

Connect to Photon to benefit from NLP and AI-powered digital technologies.

References

[1] https://www.seagate.com/files/www-content/our-story/trends/files/idc-seagate-dataage-whitepaper.pdf

[2] https://www.gartner.com/smarterwithgartner/top-cx-trends-for-cios-to-watch/

[3] https://www.finextra.com/blogposting/14691/juniper-research-cost-and-time-savings-from-chatbots

[4] https://yekaliva.ai/blog/5cdd18b0bbb06e001bfa5f5f/is-chatbot-adoption-increasing-in-2019

[5] https://www.technologyreview.com/s/612422/humans-bots-tension-and-opportunity/

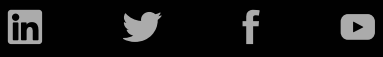
[6] https://www.gartner.com/smarterwithgartner/gartner-top-strategic-predictions-for-2018-and-beyond/

©Copyright 2023 Photon Interactive UK Limited. All Rights Reserved.



Connect with Photon now and accelerate your **digital transformation journey.**

Photon works with 40% of the Fortune 100 as their digital agency of choice. One of the largest and fastest-growing global agencies, Photon supports over 1 billion daily consumer digital touchpoints. Photon has the largest pool of experienced digital engineers with over 6000 across offices in the US, UK, Canada, Mexico, India, France, Sweden, China, and Indonesia.



www.photon.com | sales@photon.com | +1 (972) 243-3233