Personalization & Contextualization

Empowering content domains with Artificial Intelligence (AI)

NUANCE

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Introduction

When interacting with navigation systems or with apps, drivers of modern cars often have to make complex decisions. Take—for example—parking. The driver's request for parking is supported by natural language understanding (NLU) and the system finds and presents all available parking options in the area autonomously. In the last step, however, the driver needs to decide for one particular option. Choosing from a multitude of available parking possibilities and interacting with the system significantly increases the driver's cognitive load. This will not only impair driving safety. The fact that the list of options is basically unfiltered can also lead to inadequate decisions: Key requirements of the driver, as e.g. inexpensive parking or covered parking, might not be considered at all.

At this point, Artificial Intelligence (AI) technologies come into play. With contextualization and personalization—two related AI technologies—the choice becomes easier for the driver:

– **Personalization** means that the system learns certain likes, dislikes, and preferences of individual users, and uses this knowledge to make smart recommendations that match the driver's needs.
– **Contextualization** means that the system considers the current situation and circumstances together with general world knowledge, which also often affects the decision for or against a certain option.

Together, both technologies significantly improve the user experience and the driving safety by delivering more relevant results and thus helping the driver to make better and faster decisions.

At Nuance, the two mentioned AI technologies are integrated into what we call *Smart Domains*: The content domain's data is filtered and the result matches the user's personal preferences as well as the situational needs.

In the following, this document explains the terms personalization and contextualization in more detail. It also shows how Nuance uses these technologies to turn Dragon Drive Domains into Smart Domains. Finally, you will find an overview of and examples for the currently available Smart Domains.

Personalization

Giving users what they want—before they are asking for it

With personalization, the system learns about certain traits, likes and preferences of the individual user. The Nuance personalization approach starts with a user's voice requests, since speech is well suited to learn user likes and dislikes because it often contains direct representations of a person's preferences. Consider for example utterances like "Find cheap parking" or "Find some Mexican food." Both directly refer to this user's predilections, i.e. the preference for low prices and the liking for Mexican cuisine.

Nuance leverages state-of-the-art AI techniques: Based on machine learning, such voice dialogs are used to create a model of the user's likes and dislikes. By this means, user preferences in the following areas will be considered:

– **Price**: Does the user usually go for cheap options when presented with alternatives?
– **Distance**:
  - Does the user try to find e.g. parking options that are close to the actual goal?
  - Does the user try to minimize detours?
– **Accessibility**: Does the user have accessibility needs?
– **Safety**: Does the user frequently choose safe options, like guarded or valet parking?
– **Payment type**: Does the user prefer cash or credit-card payment?
– **Ratings**: Does the user favor high quality options?
– **Cuisines**: What type of food does the user like?
– **Brands**: What brands, of e.g. fast food, coffee shops, or supermarkets, does the user like?

As already mentioned, such preferences are directly learned from voice requests. Therefore, there is no special integration work necessary on the OEM side. For the user this means that better decisions can be achieved faster. User satisfaction as well as driving safety will increase significantly.

Note that Nuance offers the option to consider haptic input for learning preferences as well.

Contextualization

Doing the right thing—even if circumstances change

In contrast to personalization, contextualization is not concerned with the user as such, but rather with the circumstances that surround the user at any given moment—both inside and outside the car. Drivers travelling alone, for example, might prefer different restaurant options than drivers travelling with children. And in severe weather conditions, covered parking might be preferable to parking in the open, even if the latter is less expensive.

In addition, the system possesses world knowledge that enables the system to behave more intelligently. Consider for example the request for Vietnamese food in an area where there are no Vietnamese restaurants. If the system knows that Vietnamese cuisine is similar to Thai cuisine, it can offer this as a possible alternative: "I am sorry, I could not find any Vietnamese restaurant for you, but there is an excellent Thai place with 5 stars on Yelp just around the corner. Do you want to try this?"
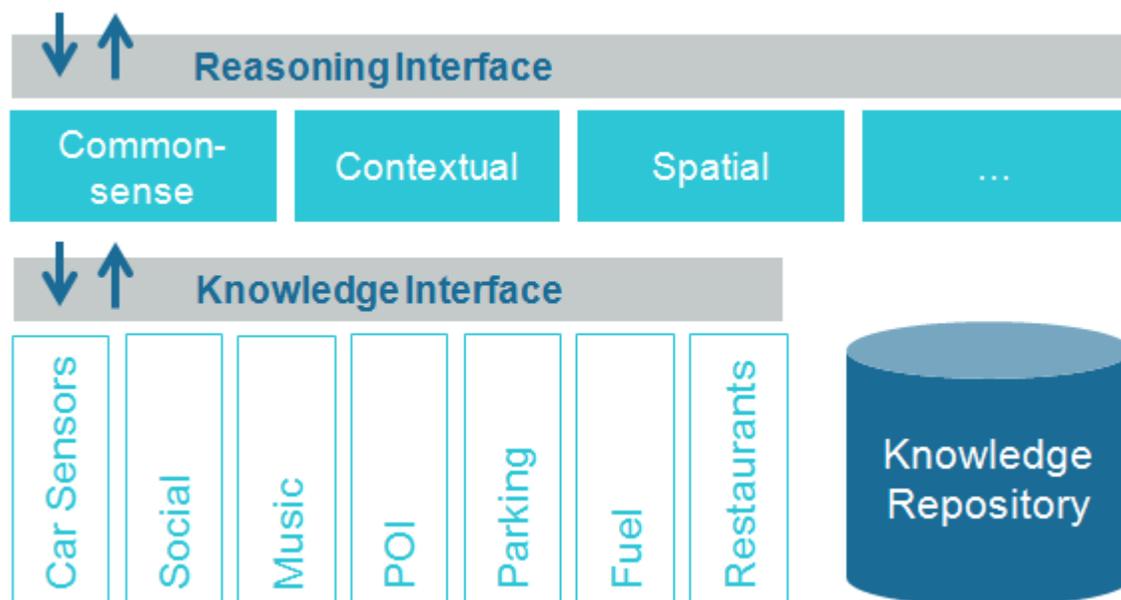
Contextualization: High-level architecture

To realize contextualization, Nuance uses a knowledge- and rule-based approach based on reasoning — an AI technology that is different from the machine learning approach deployed for personalization. One reason for this decision is that contextualization and reasoning often rely on knowledge that is established. Let's take cuisines as an example: With a machine learning approach, the system would be ignorant in the beginning and would have to learn from user interactions that Vietnamese and Thai cuisines are related and that both are Asian. During the learning phase, annoying mistakes would be unavoidable. It is much easier and provides a more satisfying user experience to directly supply the system with the required information, which is well known in advance and thus does not have to be learned.

For the integration of contextualization, Nuance needs access to the car's sensor data, like navigation data or fuel level. The data will then be processed in the cloud and integrated in the system's decision making. With the improved reaction to the user's request and in combination with personalization, contextualization further reinforces user satisfaction as well as driving safety.

Smart Domains

Prepackaged Smartness—AI out of the box

With Dragon Drive Domains, Nuance already offers prepackaged and tested application components that include advanced natural language understanding and dialog features for core automotive use cases, such as voice dialing, address entry, or music search.

Smart Domains now take the next evolutionary step: Based on selected Dragon Drive Domains, Smart Domains include the AI-driven components of personalization and contextualization as described in the sections above and thus lead to an even more convincing user experience. This enhanced user experience is currently available for the domains **Fuel**, **Parking**, **Local Search**, and **Restaurants**.

UDE Unified Destination Entry		Music	Communi cation	Office	Info Services		Car Control
Fuel	Parking	Universal Music Search	SMS+IM	Calendar	POI Knowledge	News	Car manual
Local Search	Restaurants	Internet Radio	Email	Tasks	Weather	Flights	Custom
Address Entry	Universal POI search	Podcasts	Location sharing	Reminders	Stocks	Events	
Multi-Country	Traffic		Name Dialing	Notes	Sports		

Smart Domain   Standard Domain

Dragon Drive Domains and Smart Domains overview, April 2017

Please refer to the following sections for examples on how contextualization and personalization are integrated in the available Smart Domains.

Smart Domain examples

Smart Domains use personalization and contextualization to identify those search results that ideally suit the user's needs. Rather than presenting a list of options from which the user can choose, information about the current context and the user is used to make smart, targeted recommendations.

The following sections show examples for key signals that are used by the integrated AI technologies to make suitable recommendations.

Signals for Smart Parking

– **Explicit user requests**: „I want cheap parking"
– **User profile**: Is the user disabled?
– **Learned user preferences**: The user prefers cheap parking.
– **Car context**: Car height, car width, information from car sensors (rain).
– **User context**: Is the user alone in the car? Are there family members on board?
– **World knowledge**: When it rains, you should find covered parking.

Signals for Smart Fuel

– **Explicit user requests**: „Please find cheap gas"
– **User profile**: Does the user have a loyalty card?
– **Learned user preferences**: The user prefers little detours over price.
– **Car context**: Required fuel type, information from car sensors (fuel level)
– **User context**: Is the user alone in the car? Are there family members on board?
– **World knowledge**: When the fuel level is very low, brand preferences lose importance.

Signals for Smart Restaurants

– **Explicit user requests**: „Is there an Italian restaurant nearby?"
– **User profile**: Does the user have a preferred brand?
– **Learned user preferences**: The user likes Mexican fast food.
– **User context**: Is the user alone in the car? Are there family members on board?
– **World knowledge**: Thai and Vietnamese cuisine are somewhat similar cuisines.

Signals for Smart Local Search

The Smart Local Search domain supports users when searching for POIs. POIs can be for example shops, banks, pharmacies and a variety of other categories. This Smart Domain allows the user to intelligently search for and make use of POIs:

– **Targeted search**:
  - Location is along the route
  - Location is near another location
  - Location is in an area: "downtown Montreal
  - Location position is temporally/spatially constricted: "in the next 30 minutes" or "before we pass Detroit".
  - Location is described: "the best", "good", "cheap"
  - Location has a category or brand: "Find a Starbucks", "Find a coffee shop".
– **Properties/amenities** can be taken into account: Wi-Fi or restrooms are available.
– **Implicit descriptions** are supported: "I need to get flowers", "Is there something fun for the kids?"
– **Combinations of the above**: "Find a good, cheap coffee shop with Wi-Fi along the route, before Frankfurt."

Company background

About Nuance

Nuance Communications, Inc. (NASDAQ: NUAN) is seen as the leading provider of voice and language solutions for businesses and consumers around the world. Its technologies, applications and services make the user experience more compelling by transforming the way people interact with information. Every day, millions of users and thousands of businesses experience Nuance's proven applications and professional services.

Nuance is reinventing the relationship between people and technology through speech and language solutions driven by advances in Artificial Intelligence and cognitive computing. It has pioneered the evolution of speech recognition technology that today integrates Artificial Intelligence (AI) to transform the way people interact with the devices, systems, apps, and services that surround them. Every day, millions of people and thousands of organizations experience our technology through intelligent systems that can listen, understand, learn, reason and facilitate life and work. Our clients span large companies and organizations, including hospitals, banks, airlines, carriers and car manufacturers that leverage our technologies and services to make businesses and products run more smoothly and create a better experience.

Speech is one of the most natural and intuitive ways to interact with devices, applications and systems, lessening our reliance on the mouse, keyboard and touchscreen. We have developed a broad portfolio of speech recognition and Natural Language Understanding (NLU) technologies that integrate machine learning and big knowledge for the variety of systems and services that leverage virtual and collaborative assistant offerings across devices and services in the Mobile, Enterprise and Healthcare industries. Further, our Document Imaging business drives increased productivity and security for the world's largest enterprises that need to gain control over document capture and workflows.

About Nuance Automotive

Speech recognition, NLU, AI and predictive touch solutions from Nuance have pioneered many of the personal assistant technologies and intelligent systems in the devices we use every day from the world's leading brands – including mobile devices, cars, televisions, wearable devices, and now the emerging ecosystem of the Internet of Things. We deliver a more human experience with technology, keeping consumers better connected and informed – consistently adapting to and predicting their needs.

The Nuance Automotive business delivers automotive-grade solutions enabling drivers all over the world access to information and services and providing the safest, smartest and most natural user experience. Nuance's voice technology has been shipped in more than 160 million cars from Ford, Toyota, BMW, Mercedes, Fiat and other major automakers and is at the heart of over 14 million connected car experiences on the market today. Nuance's Dragon Drive provides the industry's most comprehensive suite of solutions for the connected car, giving automakers and suppliers the ability to integrate a natural language voice interface, content, and connectivity that is customized for their individual brand.