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Revolution of Artificial Intelligence and the Internet of Objects in the Customer Journey and the Air Sector

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Abstract

Artificial intelligence (AI) is a discipline interested in the processes and methods that allow a machine to perform tasks related to human intelligence. It offers many opportunities related to problem solving, quick decision-making, increasing efficiency and reducing costs. Because of its so various fields of application, artificial intelligence is at the heart of the new industrial revolution. Algeria aims to present its AI strategy by 2020. In this paper, we are interested in defining AI, its potential fields of application, and in particular, its influence in the customer journey and position of RFID (*Radio-Frequency Identification*) in the chain; application in the aviation sector and its relationship to the Internet of Things are also described through examples.

Keywords: Artificial intelligence; RFID; Browses customer; Airline industry, IoT.

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Introduction

Artificial intelligence (AI) is not a recent area of research; the concepts associated with it date back to the fifties. Its current development is mainly due to the rapid development of the computing capacities and the availability of massive data. Thus, AI is a field of research interested in the processes and methods that allow a machine to carry out tasks relating to human intelligence, like learning, dialogue, reasoning, or understanding language.

With its many fields of application, AI is at the heart of a global entrepreneurial dynamic. The number of start-ups introducing AI into industry, medicine, agriculture, education, or defense has exploded from year to year. Moreover, it is at the center of the new industrial revolution, known as Smart Industry or more simply Industry 4.0. The reason is simple: AI offers many opportunities for problem solving, "smart" decision-making, increasing efficiency and reducing costs.

AI, as a source of innovation, is a decisive factor in the race for global competitiveness. As a result, several governments have launched significant AI initiatives. For the Canadian Institute For Advanced Research (CIFAR-2018), the criterion for implementing government strategies with regard to AI makes it possible to distinguish three main categories of countries:

- Countries with strategies with clear policies and a predefined budget;
- Countries with strategies setting out only guidance documents, setting strategic goals for designing policies but without any commitment to implementation;

Countries that have announced their intention to formulate an AI strategy or whose strategy is being developed.

Artificial intelligence and related disciplines

Definitions

Artificial Intelligence (AI) is the science whose purpose is to have a machine performing tasks that humans do using their intelligence. The terminology of Artificial Intelligence appeared in 1956, where it could preferably be called Heuristic Computing Pomian, J. (1987).

Another definition from J.L. Laurière (1988) is the –Study of human intellectual activities for which no method is a priori known. (Everything that has not yet been done in IT - when you know how to do it, it is no longer AI). It is the science of Information Processing, of interest in cases where this treatment cannot be reduced to a simple, precise, algorithmic method.

In their academic reference book in the field, Russell and Norvig Russell, S.J., and Norvig, P. (2009) defined AI as ‒the design and construction of intelligent agents who perceive their environment and take actions that affect that environment.‖ The authors pointed out that this definition goes beyond programs that "think" intelligently, i.e., that process knowledge and reason in such a way as to produce functions / behaviors usually associated with human intelligence. Thus, AI includes in addition to reflection, reasoning, adaptation, learning …, the dimensions of perception of the environment (using speech, vision …), locomotion, physical interaction, etc., until their goal is reached.

Since its beginnings in the 50s, with the use by McCarthy of the term "Artificial Intelligence" Turing, A. M. (1950) and the famous workshop he organized at Dartmouth College with the aim of bringing together eminent researchers to discuss and better understand the concept of "machines that reflect", a lot of water has flowed under the bridge. From its debut, this field is in full rise, to the point of being described as being the last scientific revolution of humanity Rahul, A., G, G. K., H, U. K., & Rao, S. (2015).

Classification

AI can be divided into two categories: symbolic AI and AI based on statistics and machine learning as described in the Algerian Artificial Intelligence Strategic Plan 2020-2030 (2019).

1) **In symbolic AI,** knowledge is generally represented in the form of logical rules (in one format or another) that allow reasoning and reaching conclusions using data (observations). Very popular in the 1980s and until the end of the last century, it was notably the basis of the famous Japanese project Fifth Generation Computer Systems (5^{th} Generation Computer Systems), which were predicted to produce a revolution based on symbolic AI. The deductive systems of this approach to AI, such as expert systems, have made it possible to present interesting solutions for problems of diagnostics (medical, electronic), systems analyzes, etc. The major problem of symbolic AI is the need to develop exhaustive knowledge covering a given field, which requires very specialized human skills and without the possibility of automating this process of knowledge extraction.

2) **AI based machine learning and statistics** is a conceptually different approach compared to symbolic AI. Logically speaking, this is an inductive inference, i.e., a generalization of a relationship from a certain set of examples (data). The techniques used are generally mathematical or statistical, but all of them make it possible to generate a model that explains the data used for learning. The model generated by induction can be mistaken on examples not seen during learning, but makes it possible to arrive at models that are most often very satisfactory, knowing that the problems treated are most often too complex for a classical algorithmic approach. In this

category, we can list techniques such as neural networks (deep or not), learning decision trees, etc.

Since the 90s and until today, the growth of AI, mainly based on machine learning, has been enormous. The results obtained were unimaginable ten years ago. This is the case for example in machine translation where the Deep Learning based methods have produced machine translators for certain language pairs (like English-French) of expert human quality. This is also the case for automatic image analysis and description systems, or virtual assistants (based on oral communication) for obtaining information or reserving seats in a restaurant.

AI has today removed its computer cap to be used in all areas of human life and technological advancement. These same AI approaches described above are used in astrophysics and chemistry, medicine and genetics, in all areas of engineering, in transport, in the management and applications of smart cities, in the sector of energy, agriculture, robotics, and industry, to name a few.

Revolution of AI in the customer journey

With AI, the mutual efforts between the physical and virtual world of a brand interfere and link. The aim of the brands is to provide customers with seamless experiences without losing information. Customer relationships are now experienced through computers, digital tablets, mobile phones, or when visiting a physical store. The consumer is now thirsty for recognition. This new trend brings a new dimension to online user journeys. As an application in this area, we will present and analyze the different stages describing the journey of a user confronted with the power of Artificial Intelligence.

Through the diagram shown in Figure 1, we can summarize the main consecutive steps in a customer chain where artificial intelligence can intervene.

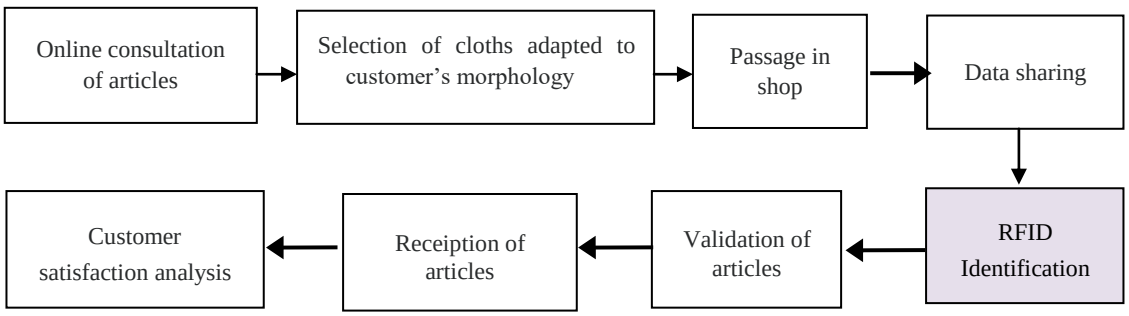

Figure 1. Application and intervention of AI at the various stages in a customer chain

Table 1 summarizes the procedure and details all steps in this operation channel.

Table 1. Procedure for obtaining customer information

Transactions carried out	AI could
He has disclosed his measurements	Determine what was his morphotype
With the list of purchases already made	Create a morphotype to categorize his profile
Based on this morphotype	Determine the types of clothing that best suit him.
Based on his purchase history	Determine his favorite colors

Step 1: Consultation of articles online: artificial intelligence intervenes for a personalized recommendation and predictive analysis based on user data. Thanks to AI, brands have the opportunity to get to know their customers better through the following points**:**

- The use of personal data from customer loyalty cards, purchasing information collected online, navigation and behavior data are all sources for detecting the consumption habits of customers.
- The AI knows a given customer purchasing behavior via his consumer profile, browsing history as well as product and text data, consulted or transaction data ….
- All of these aggregates enrich the learning of the Artificial Intelligence engine, which analyzes the customer behavior.
- When consulting his search results, the AI will direct the customer to the products that best suit his tastes and highlight the clothes with the cuts that best suit his body type.
- Provided the client has communicated his personal information beforehand to the merchant site, which should have respected the rules imposed by the GDPR (The General Data Protection Regulation) RGPD (2018), the issue is how could the merchant website have obtained such sensitive data? Table 1 summarizes the procedure.

Step 2: Selection of the cloths adapted to his/her morphology: How to customize a website to let the customer order the right size without fitting? Artificial Intelligence has the solution. AI has the ability to calculate and deduce one-person morphotype from its algorithms and refine its proposals based on the styles of clothing already purchased. Moreover, if by chance, the shopper selects a different size, it would warn him of the impact of this choice on his body type.

Step 3: going to the store: The biometric technology of the future and facial recognition at the entrance to the store has brought it closer to the customer file. Another approach is also to link the client profile identification to the use of his mobile or smart watch.

Step 4: Data sharing: Wireless connection in the service of personal data. To share a fitting with friends while forgetting to get the selfie stick started, the connected mirror is here to

help. Thanks to a simple NFC (Near Field Communication) connection Rahul, A., G, G. K., H, U. K., & Rao, S. (2015), it allows a person to recover a photo taken by the mirror with his favorite pose in the foot and without deformation.

Step 5: RFID identification: Always thanks to this fabulous mirror, one can review his list of selected items and possibly, remove the articles that did not suit him. The link with the basket or order information makes it possible to make the link with the products (manage the order, add or remove products). Solutions for identifying products in the cabin vary from RFID (Radio- Frequency Identification) tags to tags. With different technical processes, the item becomes recognizable without having to scan an identified barcode.

Step 6: validation of articles: artificial intelligence intervenes by eye identification and other fingerprint sensors. With one-click payment, fingerprinting, or eye recognition, a purchaser can finalize his order in one click and make payment. A classic mobile application allows the manipulation of the basket. Payment via eye, digital or facial recognition are still young innovations, which must be secured by banking establishments.

Step 7: receiving the articles: Traceability and tools connected to the AI service. One can check his tablet to find out where his order is despite the notifications he has already received. Thanks to the low-cost RFID chip Radio-identification. (2020) inserted in the package, one can know at a glance that the order has been dispatched, transmitted to the carrier, is in transit, or has just arrived at the warehouse near to his neighborhood. A notification will inform him of the programming of the delivery during the day with traceability of the different stages in real time.

Step 8: analysis of customer satisfaction: customer loyalty thanks to AI. Customer service can therefore questions the level of satisfaction of a client by sending him a text message or directly contacting him via his mobile. The contact person can thus suggest adding a few additional pieces to the customer initial selection. Artificial intelligence goes even further since it can maintain predict whether a product will be returned with an accuracy of around 70%.

Internet of objects and AI in the air sector

In this digital age, no airport ecosystem can ignore technological solutions. It is time to harness the Internet of Things (IoT) to discover a whole new dimension of digital transformation. Improving service delivery is an integral part of air transportation. These improvements also benefit from the unique association between IoT and AI. World economic forum connected world report estimated cost of flight delays for commercial aviation to reach 20 billion of dollars by 2020 in major US airports alone.

Benefits of IoT with Artificial Intelligence

According to a report from Deloitte Tech Trends (2017), IoT would both improve the passenger experience and boost the turnover of intelligent airport operators who rely on the latest IoT technologies with the following advantages and features:

1) Provide a pleasant customer experience,
2) Optimize the experience of travelers and buyers at airports based on mobile technologies and RFID tags (beacon).
3) Reduce and optimize passenger's boarding time using IoT tools, such as facial recognition technology.
4) Help the passenger to get on board without wasting time and/or find his way faster in the terminal. Note that if IoT changes data, there is adaptability to manage new data.

IoT applications with artificial intelligence in the aviation sector

We reviewed the positive impact of IoT on a traveler experience in terms of customer satisfaction, safety and stress reduction. Now let us discover its applications in the air transport sector.

A). Facial identification technology for security checks

Facial recognition technology Dugelay. (1970) belongs to the category of biometric software. It allows to mathematically map a person's facial features and store the data in the form of a facial print. The technology uses deep learning algorithms to compare a digital image or a snapshot with the stored facial print. This is how one can verify the identity of a person.

1) How this technology works at airports

The IoT provides an effective response to the security control issues of airport authorities and customers. Facial recognition software is used at checkpoints, where airport authorities can match travelers' facial features with data stored in blockchain systems. Each checkpoint receiving information on the identity of the customer, the time between check-in and departure gate is automatically reduced.

- The installation of automatic sensors at security checkpoints also makes it possible to shorten long queues,
- Connected to a passenger's mobile terminal, the sensors make it easy to reveal the passenger's identity and boarding information.
- In addition to baggage analysis reports, airport security teams also have access to information concerning travelers.
- On the passenger side, the sensors made it possible to reduce waiting times at security checks and thus make crossing terminals much more pleasant.

2) Example

San Jose International Airport in California D'abzac, E. (2018) is using facial recognition technology to reduce wait times at passport control points.

- All international passengers arriving and departing are screened and photographed at passport control.
- The software compares the photo with the photos of visas or passports held by the US federal government.

B). Beacons facilitating and speeding up travel at airports

Beacons can be defined as small wireless sensors, usually placed in a box. Beacon technology uses low-power Bluetooth technology to communicate with other smart devices. It is mainly used for mapping and location services that are based on the received signal strength indicator.

1) How this technology works at airports

It is now possible to have digital beacons at strategic locations in airports, which allow travelers to receive, by messages on their smartphones, updated information in real time on available parking spaces, airport shuttle schedules, restaurant reservations, etc.

- Beacons also facilitate the management of passenger flows. If a significant number of passengers are reported at an airport security checkpoint, the staff can decide to reallocate resources and redirect passengers and/or reinforce overwhelmed checkpoints.
- Smart airports guide their travelers from check-in to take-off using a tag grid that forms a digital map.
- A passenger who can easily find his way around an airport takes full advantage of his shopping or dining experience. Thus, for airports, this improved customer experience in turn generates higher revenues, airport security and operational efficiency.

2) Example

Nice Côte d´Azur Airport Airports Using Beacons (2016) has equipped its Terminal 1 with several beacons to send contextual information about its shops and promotions to travelers who wander around the terminal.

- The airport application that works with these tags allows Club Airport Premium members to automatically earn points when they travel through the airport.
- Members with Gold status have priority access to security controls. The integration of loyalty programs in the application makes passengers happier.

C). RFID tags and tags for safe baggage tracking and management

RFID is a technology in which digital data are encoded in intelligent RFID tags. A reader then captures the information by radio waves and stores it in a database. RFID tags have developed thanks to their ability to read data outside the field of vision.

1) How RFID tags and tags work at airports

IoT tags and RFID tags are essential for security, especially for baggage tracking and management. The beacons connect to the airport cellular network. RFID technology automatically detects and tracks tags attached to bags, without human intervention. The advantage compared to barcodes: RFID makes it possible to read information outside the baggage system and gives the possibility of:

- Getting live information on the location of a luggage, from check-in to the hold.
- Receiving real-time message notifications on the status of a given passenger's luggage.
- Receiving alerts inviting a passenger to route the luggage to the scheduled flights.
- Significantly improving baggage security, achieving operational efficiency gains.

2) Example

Hong Kong International Airport has installed more than 50 beacons in its Terminal 1 to activate the sending of relevant messages to travelers.

- The system even sends visuals of the luggage rugs to the application based on the tag system.
- The airport guides travelers through its main areas using user-friendly and interactive maps.

D). Bluetooth wireless sensors to reduce flight delays

Bluetooth beacon sensors used by Outsourcing Custom Software Development company in Ukraine. (2017) provide data. They are equipped with detection devices dealing with movement location (accelerometer), atmospheric pressure, temperature, humidity, magnetism (Hall Effect), light, proximity, heart rate, near-field communication (NFC), and falls. Using low-energy Bluetooth technology for data transmission, these sensors are best suited for IoT and artificial intelligence applications.

1) How beacon sensors work in airports?

It is possible to link simple weather monitoring beacons on each runway with the extended airport network. Network monitoring can provide accurate and up-to-date information for passenger applications to find out the reasons behind interruptions or delays experienced during their journey. The monitoring of the runways is, in particular, very useful in the event

of a brutal flood and ice - these meteorological episodes being unpredictable. Airports can thus make decisions that are in the interest of passenger safety.

E). Proximity sensors for observing passenger flows and behavior at airports

Proximity sensors as in Singh, S. (2013) are called sensors that convert information, depending on the presence of an object or movement, into an electrical signal. These devices detect nearby objects without any physical contact within a nominal range.

1) How do proximity sensors work in airports?

Proximity sensors help link technologies used by airlines and airports with travelers' smartphones. According to the Unacast Proxbook Q3 2016 Report (2016), nearly 90% of airports worldwide are in the commercial deployment or pilot project phase on the issue of proximity sensors. Report estimates proximity sensor market at $ 52.46 billion by 2022.

- Proximity sensors improve airport security and passengers' experience.
- Security teams can assign staff reinforcements to denser areas of the airport, allowing merchants to broadcast their promotional messages and special offers on the smartphones of travelers near the store.

2) Example

Gatwick Airport in the United Kingdom Lomas, N. (2017) uses beacons and proximity sensors to facilitate circulation within its walls. Collecting generic information on "population density" levels in the various areas covered by the beacons improves airport operations.

Conclusion

Artificial Intelligence is making a remarkable entry into the Retail space. Brands looking to implement an artificial intelligence strategy want to build a Unique Customer Repository. This must allow to have a unique and global vision of each client in an omnichannel environment. Artificial Intelligence now incorporates this ability to perform predictive analysis in real time on a customer journey. AI thus unifies all data from information systems, the objective being to optimize the turnover, to make the customer more captive, more loyal.

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