An analysis on how can AI empower the senior population in their access to banking services

Yolanda Alfaro Peral[1], Eugenio Concepción[2], Izaskun López-Samaniego[1], and Gonzalo Zarza[1][0000−0003−0795−0933]

[1] Design and Data & AI Studios, Globant, Spain
{yolanda.alfaro, izaskun.lopezsamaniego, gonzalo.zarza}@globant.com
[2] Facultad de Informática, Universidad Complutense de Madrid, Spain
econcepc@ucm.es

Abstract. This article addresses the banking interaction needs of the senior population, devoting special attention to the unique needs of this age demographic delineated by the natural cognitive decline caused by ageing. Despite being a compelling business audience, the nancial sector, and particularly banking institutions, have signi cantly underestimated the importance of designing a customer experience that is better adapted to the needs of senior users. A compelling yet achievable solution to this problem is the adoption of AI-based technologies, such as dynamic user interfaces, biometric authentication methods, automatic recommendations, and experience-based APIs. The curated adoption of these tools will enable banks to better serve this increasingly growing population by creating seamless and respectful experiences for their senior customers and, above all, will provide them greater autonomy.

Keywords: Elderly People · Digital Solutions · Business Model · Social Responsibility · Arti cial Intelligence.

1 Introduction

The increasing ageing of the population, in combination with the spread of digitalisation of businesses and services, has introduced a growing urgency to bring to centre stage the needs of elderly people. This statement is not a mere headline, since 33% of Europe's population will be aged 60+ in 2050 [1], [2], compared with 24% in 2016 [3]. Focusing on this age demographic segment as a distinct target constitutes, not only a considerable source of income for the nancial sector but, more importantly, a social responsibility [4].

As Srividya highlights in [4], there are nearly 104 million elderly persons just in India, according to the 2011 Census. This implies a huge potential for the nancial institutions to expand their customer base and build a reputation for old age-friendly banking service. While banks and other nancial institutions do offer products for senior citizens, they do not seem to have developed a comprehensive program to fully address the middle to low income older adults' unique nancial concerns [4].

Despite older groups get much higher income and loyalty ratios, it is common for companies to promote themselves directly to younger age demographics, regardless of the fact that they are typically the segment with the least purchasing power, propensity

to pay, as well as loyalty. As Du Toit and Burns point out, "Digital channels often are not as effective as banks would like; many consumers trying these channels contended with various problems and wound up visiting a teller or calling a contact center anyway" [5]. In contrast, older groups are recurrently not prioritized, or directly ignored, in digitisation processes.

In this context, the COVID-19 pandemic has highlighted the increased vulnerability of our aging population, as well as the need to rethink the basis for the interaction design in the current digital business models.

The development of custom-made functionalities for our elderly is not only a need or a social responsibility, but it is also a great business opportunity, as well. The rest of this paper is devoted to the analysis of plausible and economically-viable AI-powered alternatives to overcome this problematic. First, the background and motivation of analysis are presented in Section 2. Then, the proposed solution approach is introduced and described in Section 3. Finally, a brief discussion and conclusions are drawn as closure in Section 4.

2 Background and Motivation

2.1 What happens when our brain starts to fail?

Cognitive deterioration commonly starts in almost all people by the age of 64, and this process increases along with age or the appearance of neurological diseases, as illustrated by Mustafa et al. [6] in Fig. 1. Auspiciously, there are different technologies that can be of great help to solve the problems that can come with this deterioration, such as biometrics, experience-based API Patterns, or automatic recommenders.

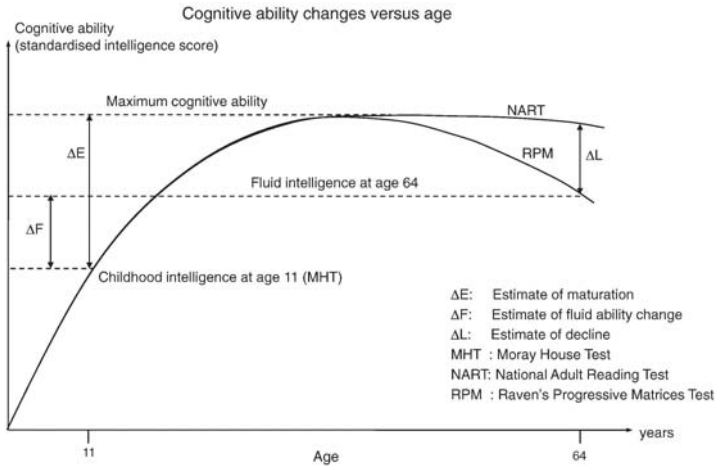

Fig. 1. Cognitive Ability Changes Versus Age (Source: [6]).

2.2 Where should we start?

Undoubtedly, the nancial industry, and specially the banking sector, is one of the most important economic and social actors in the world. Over the last years, the reduction in the number of bank branches, along with their corresponding ATMs, has forced bank customers to utilize self-service digital channels, putting elderly customers in a vulnerable situation. The graphs in Figs. 2 and 3 illustrate the magnitude of this paradigm shift, depicting how banks have reduced the number of offices and ATMs in the Eurozone and the United States during the last decade.

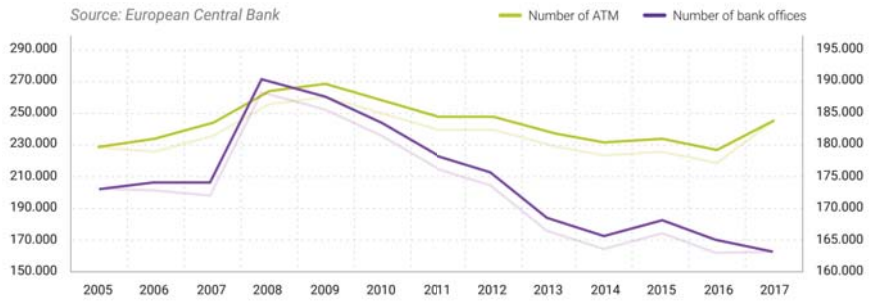

Fig. 2. Bank Branches and ATMs Evolution in the Eurozone.

Fig. 3. Branches Evolution in Europe and USA per 100,000 inhabitants (Source: [7]).

2.3 How can we help?

Technology is a tool that can help simplify our lives. There is relevant evidence that highlights the positive impact of technology as the foundations for creating a new dif-

ferential digital experience for the elderly, with a strong focus on their own autonomy. Nowadays, it is possible to leverage relevant data and scienti c evidence to identify signi cant opportunities to create new respectful and pragmatic multichannel experiences for the senior population. It is now possible to harness state of the art technology to design experiences that require less memory and attention, and truly adapting the experience to the users, and not the other way around.

Some of the technological aspects that we need to take into account to address this problem:

- **Creating a dynamic UI-UX with interactions adapted** in response times, fonts and sizes and only necessary actions and features [8]. By working on accessibility and information architecture, we can reduce the cognitive workload and atten the learning curve. For example, we can improve accessibility by adapting the font size to increase readability. We can work on information architecture to increase ndability and remove those functionalities in the website that could be useless for these customers.
- **Using voice or facial recognition to order or con rm** operative payments, transfers, etc. The elder people will no longer need to memorise their personal access keys. The introduction of facial and voice recognition is a simple and proven way of authentication which eliminates the risk of forgetting a password or introducing erroneous information. These techniques are suitable for various scenarios such as digital and phone banking.
- **Adapting the information, management, and monitoring channels** to the older target audience, understanding exceptions to self-management and helping through remote access. Not everyone is able to operate by means of a mobile application nor understanding the provided information, but all the customers could require assistance or information. Accordingly, we are proposing to revisit the prevailing trend of promoting self-service and developing a digital omnichannel strategy. Although we consider this trend adequate in general terms, we highlight the need for establishing exceptions regarding information access and e2e assistance for the groups we are analysing in this paper.

3 Our proposal: technology to the rescue

In the following paragraphs, we introduce and describe the outcomes of our efforts to empower the senior population in their access to banking services. We have put special emphasis in the study of the applicabilities of three different AI-enabled solution families: automatic recommenders (section 3.1), experience-based APIs (section 3.2), and biometrics (section 3.3).

The widespread use of *automatic recommenders* has the potential to enable a meaningful improvement of the user experience. In the case of our older, senior demographic, the use of recommenders can range from the selection of menu choices to be shown to the user while navigating, to the type of nancial products that would interest a senior customer.

Similarly, the concept of *experience-based API* leads to many potential applications. Concerning the older demographic, this approach would help to design a set of customer-centric services with a special focus on senior needs which combined with the use of recommendation techniques, the API can be adequately adapted to serve the needs of the devices and the user pro les.

In addition, the use of *biometrics* could strongly simplify the authentication process. A facial recognition interface, enhanced with the use of voice recognition, would allow older demographics of users a seamless login and easy access to the services she/he needs. The use of special devices, such as totems in a bank office, would also reduce the time spent queuing and give them access to the personal assistant line immediately.

3.1 Automatic Recommenders

Recommender systems are effective tools to predict user preferences and suggest choices in a complex choice-making context [9]. They have become obvious components in applications such as electronic commerce platforms and information query tools, providing suggestions that smartly prune large sets of options so that users are directed toward those that best meet their needs and preferences.

There is a broad range of recommendation techniques such as content-based, collaborative, knowledge-based, and others. They all provide both advantages and disadvantages, and the best choice depends on the context of the problem we need to solve [10].

As we review the existing recommendation techniques along with their main features, it is noteworthy to mention that there are several models of classi cation. In this paper, we have adopted the Burke perspective [10].

Collaborative recommendation is the most popular strategy, both widely implemented and well proven. The collaborative approach focuses on gathering the ratings provided by the users about the diverse choices and nding commonalities among users according to their rating behaviour. There are several variations of this technique: binary ratings, percentage of affinity ratings, predictors based on Bayesian networks, neural networks, and latent semantic indexing. A valuable feature of the collaborative strategy is its ability to provide recommendations outside-the-box, that is, the ability to nd options that the user has never rated, based on the choices of other similar users. The main shortcoming of this approach is the well-known "ramp-up" problem [11]. This term actually refers to two distinct but related problems: the new user (a user with few or no ratings cannot be classi ed) and the new option (an option with few or no ratings can barely be recommended). Another common problem is data sparsity, which happens when the space of ratings is sparse, that is, when only a few users have rated the same items.

Demographic recommender systems base their operation on categorizing the users according to their personal attributes and make recommendations based on demographic classes. The representation of such demographic information varies greatly from one system to another. The classi cation criteria depend on the objectives that the system must achieve. The main advantage of this approach is that it does not require a history of user ratings, so it can provide recommendations even with no previous user activity.

A content-based recommendation system stores information about the features of the different options available, and considers the ratings provided by the users to map the user behaviour with the features. Leveraging this information, the recommender can estimate the rating that a user would give to a particular option. Content-based techniques do have a start-up problem in that they must accumulate enough ratings to build a reliable classi er.

Utility-based recommenders generate a utility function that allows them to make suggestions based on a calculus of the utility of each option for the user. Developing such a utility function for each user is the key non-trivial activity for this strategy.

Knowledge-based recommendation analyses the needs and preferences of the users to understand what they need.This kind of system has knowledge about how a particular option meets a particular user need, and can reason about the relationship between a need and a possible recommendation. Such knowledge can be gathered and expressed in multiple ways, depending on the context of operation. Both utility-based and knowledge-based techniques do not have ramp-up or sparsity problems since they do not base their recommendations on accumulated statistical evidence.

Taking into consideration the limitations of single strategies, we have evaluated hybrid strategies to overcome the constraints of single techniques by combining them. This analysis does not intend to be an exhaustive list of all existing hybridisation strategies, but a representative panorama of the most interesting combinations.

In the mixed combination, the recommendations from two different recommenders are presented at the same time to the user [10]:

1. The Cascade approach pipelines the output of one recommender as the input to another one, which re nes the recommendations given by the previous step.
2. The Weighted approach, where several recommendation techniques are combined together, according to a set of numerical weights, to produce a single recommendation.

Most commonly, collaborative ltering is combined with other techniques in order to avoid the ramp-up problem. The combination of collaborative ltering with content-based and/or demographic techniques is one of the most frequently used [12], [13], [14].

The navigation across a banking website is one of the rst candidates to be enhanced with automatic recommenders since it is not always user-friendly, especially for senior users. The customer is commonly required to navigate through a large number of options with technical names that are not always intuitive. A proper study of the needs and behaviours of senior users would lead to the development of a recommendation-based assistance system to help them during the interaction.

3.2 Experience-based API

An API ecosystem provides secure access to data resources through rewalls, proxies, and API gateways, allowing for new business models and offering a platform that supports the development of new digital products [15].

The concept of Experience-based API is a solution for enriching and/or personalizing the interaction between producers and consumers [16]. Concerning the older demographic, this approach would help to design a set of customer-centric services with a special focus on senior needs.

The most obvious application of the experience-based approach is the tailoring of pre-existing APIs to better meet the needs of the consumers, as depicted in Fig. 4. Another application, closely related to the previous one, is the abstraction of the source. This introduces an additional layer of abstraction that enhances the decoupling of consumers and producers and simpli es the coexistence of different versions of the same API.

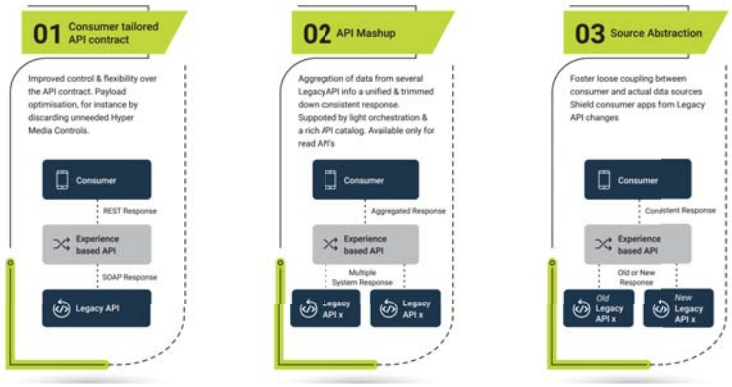

Fig. 4. Experience-based API Patterns (Source: [16]).

Lastly, the mashup pattern allows for building a composite API that provides an integrated view of the resources which can perfectly be backed by different systems/API. This pattern can be very helpful when building tailored views for different consumers of a system of resources.

Combined with the use of recommendation techniques, the API can be adequately adapted to serve the needs of the devices and the user pro les developing a new layer of mediation or abstraction is placed between the consumers of the API and the providers of the API. The published resources may be adapted to mobile, web or IoT scenarios depending on customer and/or security needs.

There are multiple backgrounds in which an Experience-based API approach can be helpful [16]:

- **Adapting to consumer needs:** the available API is coupled to an existing product but the consumers need an adaptation of the exposed resources.
- **Hiding complexity:** in an ecosystem in which there are resources that belong to multiple back-end applications, databases or other sources, providing a homogeneous access to this variety of resources is a must, and the use of this approach allows for abstracting the consumer from complexity.
- **Data governance:** when it is necessary to synchronize data from a variety of services, even when they belong to different business domains. Many departments within an organization make their own purchasing decisions for the products they use and both central control and data governance can be lost.
- **Properly manage application integration expectations:** a digital business application is being introduced to the market and customers of this application will expect integration with the SaaS applications they use within their organization.

3.3 Biometrics

In this paper, we will adopt the simple yet accurate biometrics de nition provided by Jain et al. in [17]: "Biometrics is the science of recognizing the identity of a person based on the physical or behavioural attributes of the individual such as face, ngerprints, voice and iris".

There are two common tasks that facial recognition systems perform: veri cation and identi cation. Veri cation refers to the unambiguous identi cation of a person. Some typical usages of this technique are checking the user's face to unlock smartphones and automatic passenger screening during plane boarding [18]. There are two types of identi cation based on the awareness and cooperation of the person being identi ed. If the person that is being identi ed is aware and tries to facilitate the process, it is "cooperative identi cation". On the contrary, if the person is unaware that they are being identi ed, it is "non-cooperative". This variable has an obvious impact on the accuracy of the recognition process.

In the last decade there has been a technological breakthrough in how the use of biometrics can strongly simplify the authentication process. A facial recognition interface, enhanced with the use of voice recognition, would allow older demographics of users a seamless login and easy access to the services she/he needs.

The use of special devices, such as totems in a bank office, would also reduce the time spent queuing and give them access to the personal assistant line immediately. The range of potential applications continues to grow: border control, user authentication, law enforcement, control facilities, etc.

According to Crumpler, "In ideal conditions, facial recognition systems can have near-perfect accuracy. Veri cation algorithms used to match subjects to clear reference images, like a passport photo, can achieve accuracy scores as high as 99.97% on standard assessments like NIST's Facial Recognition Vendor Test (FRVT)", and highlights that even banks feel comfortable to use these techniques to log their users [18]. However:

- Lighting and positioning play a vital role to achieve a high level of accuracy so the facial features of the individuals must be clear. The error rate can rise from 0.1% under ideal conditions to 9.3% in a real-world scenario [19].
- The awareness and cooperation of the person being identi ed has an obvious impact on the accuracy of the recognition process.

For this reason, commercial algorithms are often set to only return a match if they have a certain degree of con dence in their assessment to avoid false positives, especially in those scenarios where identifying the wrong person can have severe consequences, such as an ATM authorisation system.

The use of con dence thresholds can signi cantly lower match rates for algorithms as they force the system to discard positive but low-con dence matches [18]. This authentication method can be combined with other biometric technologies to ensure a completely accurate authentication, such as the application of voice-based authentication.

4 Discussion

Undoubtedly, the introduction of cutting-edge technologies will enable the design and implementation of a holistic experience for senior customers that will signi cantly improve their banking quality of experience (QoE). However, it is worth noting that despite great advances made thanks to AI-powered technologies and automation techniques, there are still important challenges that need to be overcome in terms of User and Customer Experience. For instance, the great potential of facial recognition can still be ballasted by inadequate lightning conditions or by poor quality datasets.

Notwithstanding, beyond improving the customer experience, the adoption of AI-powered solutions are already making it posible to improve the day-to-day lives of millions of people who are deprived of their autonomy when operating with their banking entities. It is now possible to seriously consider an issue that has been largely ignored: that the digital transformation process must take into account all age demographics in society, and not just the youngest.

One of the lessons that COVID-19 has taught us is that the older age demographic is one of our most vulnerable groups, and not only because of the incidence of the disease.

Fortunately, all the techniques discussed above are facets of a combined architecture exclusively oriented to increase the welfare of senior customers and help them to improve their relationships with their banks.

Bibliography

[1] Rafal Chomik and John Piggott. Population Ageing and Social Security in Asia. *Asian Economic Policy Review*, 10(2):199–222, 2015. https://doi.org/https://doi.org/10.1111/aepr.12098. URL https://onlinelibrary.wiley.com/doi/abs/10.1111/aepr.12098.

[2] J. P. Michel, B. L. Beattie, F. C. Martin, and J. D. Walston. *Oxford Textbook of Geriatric Medicine*. Oxford Textbook. Oxford University Press, 2018. ISBN 9780198701590. URL https://oxfordmedicine.com/view/10.1093/med/9780198701590.001.0001/med-9780198701590.

[3] United Nations. *World Population Ageing 2017 Highlights*. United Nations Documents. UN, 2019. ISBN 9789211515510. URL https://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2017_Highlights.pdf.

[4] P. N. Srividya. Making banking a delight for the elderly, May 2018. URL https://www.edgeverve.com/blogs/making-banking-delight-elderly/. [online; accessed on April 2022].

[5] G. Du Toit and M. Burns. Customer Loyalty in Retail Banking: Global Edition 2016, November 2016. URL https://www.bain.com/insights/customer-loyalty-in-retail-banking-2016/. [online; accessed on April 2022].

[6] Nazahah Mustafa, Trevor S. Ahearn, Gordon D. Waiter, Alison D. Murray, Lawrence J. Whalley, and Roger T. Staff. Brain structural complexity and life course cognitive change. *NeuroImage*, 61(3):694–701, 2012. ISSN 1053-8119. https://doi.org/https://doi.org/10.1016/j.neuroimage.2012.03.088. URL https://www.sciencedirect.com/science/article/pii/S105381191200376X.

[7] José Francisco López. ¿Desaparecerán las sucursales bancarias?, May 2018. URL https://economipedia.com/actual/desapareceran-las-sucursales-bancarias.html. [online; accessed on April 2022].

[8] W3C. Developing Websites for Older People:How Web Content Accessibility Guidelines (WCAG) 2.0 Applies, January 2018. URL https://www.w3.org/WAI/older-users/developing/. [online; accessed on April 2022].

[9] Robin Burke. Knowledge-based recommender systems. *Encyclopedia of library and information systems*, 69(Supplement 32):175–186, 2000.

[10] Robin Burke. Hybrid recommender systems: Survey and experiments. *User modeling and user-adapted interaction*, 12(4):331–370, 2002.

[11] Joseph A. Konstan, John Riedl, Al Borchers, and Jonathan L. Herlocker. Recommender systems: A grouplens perspective. In *Recommender Systems: Papers*

from the 1998 Workshop (AAAI Technical Report WS-98-08), pages 60–64. AAAI Press Menlo Park, 1998.

[12] Mark Claypool, Anuja Gokhale, Tim Miranda, Pavel Murnikov, Dmitry Netes, and Matthew Sartin. Combining content-based and collaborative lters in an online newspaper. In *Proceedings of ACM SIGIR workshop on recommender systems*, volume 60, pages 1853–1870. Citeseer, 1999.

[13] Michael J. Pazzani. A framework for collaborative, content-based and demographic ltering. *Arti cial intelligence review*, 13(5):393–408, 1999.

[14] Barry Smyth and Paul Cotter. A personalised TV listings service for the digital TV age. *Knowledge-Based Systems*, 13(2-3):53–59, 2000.

[15] Daniel Jacobson, Greg Brail, and Dan Woods. *APIs: A strategy guide*. O'Reilly Media, Inc., 2012.

[16] Ross Garret. API Mediation: Why You Need an API Experience Layer, May 2017. URL https://nordicapis.com/api-mediation-why-you-need-api-experience-layer/. [online; accessed on April 2022].

[17] Anil K. Jain, Patrick Flynn, and Arun A. Ross. *Handbook of biometrics*. Springer Science & Business Media, 2007.

[18] William Crumpler. How Accurate are Facial Recognition Systems–and Why Does It Matter?, April 2020. URL https://www.csis.org/blogs/technology-policy-blog/how-accurate-are-facial-recognition-systems-âĂŞ-and-why-does-it-matter. [online; accessed on April 2022].

[19] National Institute of Standards and Technology, U.S. Department of Commerce. FRVT 1:1 Leaderboard, February 2020. URL https://pages.nist.gov/frvt/html/frvt11.html#overview. [online; accessed on April 2022].