Artificial Intelligence and Generative Neural Systems: Creating Smarter Customer Support Models for Digital Financial Services

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Abstract

Artificial Intelligence and Generative Neural Systems are still evolving technologies in finance and economics. With hardware advancements, it is now possible to create smarter models for customer support for digital financial services. The focus will be on generative neural systems, which are a branch of Artificial Intelligence. Generative neural systems on the cloud can create open-source, custom-made general systems, trained on company data to provide various financial services and products for customers 24/7. Generative systems will be created with an emphasis on reinforcement training for discovering new smart financing adjustment procedures based on customer behaviour in regard to offered digital financial services. It will analyse parameters for the generative neural systems outside the company, data cloud, basic training and expansion, and stress open-source software packages customisation into fully functional cloud services. First, pretrained generative systems will be adapted to the companies with safety concerns and obligations in regard to customers logged-in access to all services. All types of financial services will be applicable for chat text based on the cloud model style on the customer interface side. Chat generative services could be modelled in different operable styles. Models trained on the general data preparation approach could herd customer questions across the system, directing them for clarifications towards the best supported financial services or products. Avoiding treatment questions outside the offered services or products will be a requirement for customer education about finance digital or otherwise.

Keywords: Artificial Intelligence, Generative Neural Networks, Customer Support Models, Digital Financial Services, Machine Learning, Natural Language Processing (NLP), Generative AI for Customer Service, Intelligent Chatbots, Customer Sentiment Analysis, Neural Networks for Customer Support

1. Introduction

The objective is to propose a novel customer support and service architecture for digital financial services based on generative neural systems. An overview of generative neural systems is conducted, focusing on large generative language model architectures. Potential opportunities for creating smarter customer support models for finance are discussed. A preliminary architecture with key components is introduced, and possible risks are pointed out.Digital financial services are on the rise, with customer service at the heart of newly emerging business models. Financial firms continue to invest in service automation using artificial intelligence technologies. Generative neural systems have quickly advanced and found a wide range of implementations. Automated smart virtual agents, created using generative neural systems, have great potential for improving customer service and support in finance. However, financial firms currently rely on either simple rule-based chatbots or generative systems trained on vast language models, with little understanding of risks and unintended consequences.

1.1. Background of AI in Customer Support

The social and commercial sectors of the planet are undergoing a fast and enormous transformation process, with velocity and magnitude that have never before been observed. The entire shift is fueled by the proliferation of digital systems capable of automatically collecting, processing, and analyzing vast volumes of digital data. It is as if everything was on a quest to be digitized, and then made searchable, analyzable, and insightful. A critical component of this shift is the emergence of a new class of smart systems, which can adapt and self-improve their performance by acquiring and formalizing new knowledge. The use of Artificial Intelligence (AI) systems is continuously growing in society, as they play a crucial role in producing knowledge and delivering it to the moment of need. The text analyses the importance and design of Generative Neural Systems as a new class of intelligent systems that are capable of creating knowledge in the form of digital artifacts. It focuses on the development and deployment of Generative Neural Networks in designing and creating smart Customer Support Assistants for Digital Financial Services (DFS). Customer Support in the Digital Age and Artificial Intelligence in Customer Support assist customers in achieving their goals. Customers interact with Digital Financial Services to achieve some goals, take actions, and produce results.

1.2. Importance of Customer Support in Digital Financial Services

This research focus aligns with the strategic directions set by the European Commission for the HORIZON 2020 program and, in particular, the Digital Europe programme, which seek to strengthen Europe's technological sovereignty and the trustworthiness and security of its digital infrastructure. These strategic objectives are particularly relevant in the context of artificial intelligence. The ambition is to ensure that AI is developed in a trustworthy manner, based on Europe's respect for human rights and democratic values. In addition to addressing these societal and ethical challenges, there is also a need to support the widespread adoption of AI in industry, especially in small and medium-sized enterprises (SMEs), which constitutes 99% of all European businesses. In particular, there is a strong need to increase the availability of AI for low-risk and non-critical business applications. Building on their long-standing collaboration in applied research with a focus on the financial services sector, the authors' research group in AI at their universities will leverage and adapt their existing artificial intelligence technologies to create, innovate, and demonstrate smarter customer support models—using AI and GNNs—for low-risk business applications in financial services.

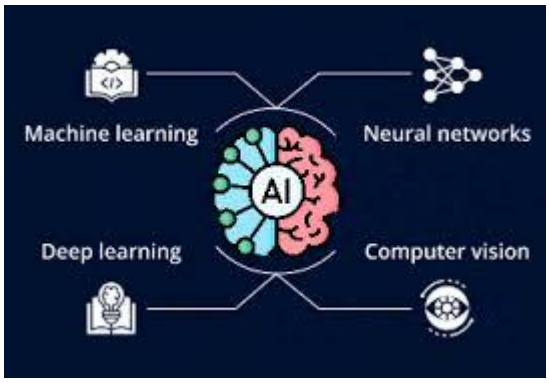

Fig 1: Generative AI: Tech stack, framework, models and applications

In recent years, the digital transformation of the financial services sector has accelerated due to the COVID-19 pandemic. The rapid adoption of digital financial services (DFS), including online banking, investing, payments, and remittances, has prompted financial services providers to improve their responsiveness in acquiring and retaining customers. To enhance or build their digital customer acquisition, onboarding, and engagement capabilities, financial services providers have turned to emerging technologies such as Artificial Intelligence (AI). Customer

support plays a crucial role in the customer life cycle and is essential for successfully developing DFS. This highlights the importance of researching and developing AI and generative neural network (GNN)-based customer support solutions specifically tailored for DFS.

Equation 1 : Machine Learning for Consumer Segmentation in Travel

$$y = f(Wx + b)$$

Where:

- y is the predicted consumer segment (e.g., adventure travelers, luxury travelers),
- x is the input features (e.g., demographic data, previous travel history),
- W and b are the model weights and bias.

2. Generative Neural Systems

In context, the generative model learns to generate new instances of training data by modeling the joint distribution of observed and latent variables. It can generate customer queries, system design ideas, and other applications by learning from customer interaction data in the designed representation style. Other neural network architectures, such as reinforcement learning and autoencoders, can model the data generation process. The data representation model maps raw data to a latent representation space where the semantic relationship is preserved, enabling the generative model generalization. It uses a distribution-based model to represent street input data. The feature extraction model extracts relevant features from the input data necessary for the generative model training. It usually adopts a neural network architecture to compute high-level semantic representations of continuous or symbolic data. Generative systems use man/machine interactive interfaces to attract users and create generative data. Machine-interactive systems utilize user-applied query data to investigate designer systems.

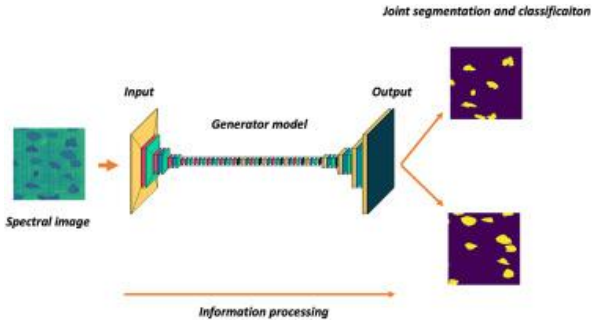

Fig 2: Deep generative neural networks for spectral image processing

Generative neural systems represent a class of artificial intelligence systems capable of generating new and original content, designs, or solutions based on learned patterns and data. Unlike traditional AI systems that focus on data analysis and prediction, generative systems excel in creativity and innovation. Generative systems apply a generative neural network trained to produce new instances of data similar to an existing dataset. Generative neural systems are complex deep learning frameworks with multiple components, including a generative model, data representation model, feature extraction model, training algorithm, and user-interface-driven application.

Equation 2: Optimization of Travel Package Personalization

$$Q(s_t, a_t) = r_t + \gamma \max_{a'} Q(s_{t+1}, a')$$

Where:

- $Q(s_t, a_t)$ is the expected reward (satisfaction from travel experience) of taking action a_t in state s_t,
- r_t is the immediate reward (e.g., booking a preferred travel package),
- γ is the discount factor, and
- s_{t+1} is the next state (e.g., user feedback or subsequent travel behavior).

2.1. Overview of Generative Neural Networks

Generative neural networks can be categorized as autoregressive models or non-autoregressive models. The generative neural networks that are currently monitored in the news mostly belong to the autoregressive group, wherein the AI creates

new data one element at a time. In these systems, the display of newly created elements is conditional on previously generated elements. The generative networks in the 'non-autoregressive' category can create data in parallel. The AI generative networks can be either text-based or non-text-based. Text-based generative networks read and create only text patterns, while non-text-based generative networks transform or create non-text data using text prompts. Data transformations or data creations in generative networks are triggered by user-created textual prompts. Text formats of prompts control the temperature and randomness of the data transformation or creation process. Generative neural networks define a group of AI models that can create new data. Local or online datasets of previously created data (or their representations) can be ingested into generative neural networks and used as training resources for creating new data. AI models create data by approximating the probability distribution of the training dataset and then sampling from the learned distribution. Because of advancements in computational power, data availability, and algorithms, generative network architectures have become more sophisticated and widespread . Experiments with generative networks have resulted in the creation of images, artwork, music, videos, 3D objects, text, protein structures, game levels, and many other data types. Need-based generative network applications in research, business, art, or entertainment are limited only by imagination and ethics.

2.2. Applications in Customer Support

Knowledge bases are at the heart of the customer support systems, storing, organizing, and maintaining the information resources needed for customer service, self-support, and human agent-assisted support. Smart text generation, augmentation, and retrieval methods based on generative or discriminative neural models enhance the flexibility, efficiency, and robustness of customer support systems by transforming the textual knowledge representation from a fixed format into a dynamic one. On-demand generation of text answers to customer questions is the main element of the text-based customer support systems.An important component of the digital transformation in finance is the digitization of customer interactions. This includes provision of web- and app-based customer interface channels, availability of computer-driven interaction channels, so-called robo-channels, and behind-the-scenes automation in data handling and process execution. Digital financial services (DFS) rely on a wide range of customer support services to ensure an effective customer experience in using the offered functions and services. Typically, these support services combine self-support facilities and human agent-assisted support, with the goal to minimize human agent involvement by increasing the efficiency of self-support.

3. Integration of AI and Generative Neural Systems in Digital Financial Services

Generative models are AI systems that can create new content, from designs to text, images, or sound. Content production uses Generative Neural Systems (GNS), a crucial AI component. GNS relies on Generative Models (GM), trained on datasets, generating new statistical instances. The connection between AI and GNS is foundational learning. AI systems learn from massive, carefully curated datasets, modeling company activities probabilistically. Trained on current business data, AI and GNS enhance cloud-native telecom strategy modeling service development. AI is used in creating smart customer support models for consumer digital financial services, focusing on generative or foundation neural systems. Co-created with clients, AI models use company-provided data, tailoring service generation to business needs.

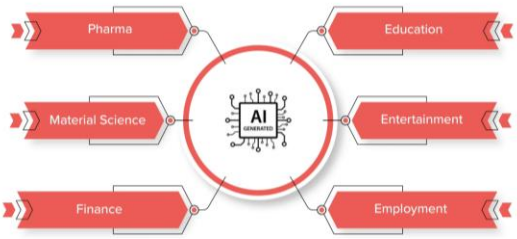

Fig 3 : Using Generative AI for Business to Solve Complex Problems.

A generic AI model prototype is developed, ensuring cross-telecom company applicability and consumer digital financial service versatility. AI model prototyping assists companies in building AI service

data and foundation model co-development skills. Clients can independently develop AI services with generative models for various use cases, streamlining new service modeling by supporting AI consumer internal model use. The need for generative foundation model customer support modeling services in consumer digital financial services arises from growing use cases and emerging telecom generative model customer support services. Focus is on smart customer support modeling service generative foundation models and AI system integration. Consumer digital financial services include banking, payments, investments, insurance, and financial advisory services provided by fintech and telecom companies. Smart service is remotely provided with minimal human involvement, using AI for data management and decision-making in service generation. Services can be fully automated, AI-generated, or human-AI hybrid, where humans perform AI service-generated tasks, enhancing AI role effectiveness from model training and data involvement perspectives.

Equation 3: Generative Model for Customer Query Response Generation (Using GPT-like Architecture)

$$P(x_{t+1}|x_1, x_2, ..., x_t) = \frac{\exp(\mathbf{W} \cdot \mathbf{h}_t)}{Z}$$

Where:

- $P(x_{t+1}|x_1, x_2, ..., x_t)$ is the probability of the next token x_{t+1} given the previous tokens,
- $\mathbf{h}_t$ is the hidden state of the transformer at time t,
- $\mathbf{W}$ is the weight matrix for generating the next token,
- Z is the normalization factor (softmax).

3.1. Challenges and Solutions

Digital financial services are increasingly incorporating automated customer support models. As chatbots and virtual agents permeate customer support channels, banks are rushing to keep pace with digital change. Such models can be built based on rule-based systems or AI technology. AI systems can be language-driven agents, capable of understanding and generating human language using machine learning (ML) models and artificial neural networks (NN). This research concentrates on generative dialog models that support low-level conversational framing in a given domain. Generative models take the entire conversation history as input and produce the next dialog act distribution. Systems of this type can outperform simpler processing models that ignore past system acts but account for past user acts only. Still, such models may have problems managing multi-topic conversations because users can shift topics freely without system contribution or acknowledgment.The rapid rise of artificial intelligence (AI) technologies in finance could widen rather than diminish the gulf between the tech elite and wider society. Addressing this potential dilemma, this research aims to support the adoption of AI in the digital retail banking domain, enabling the creation of generative neural systems that can improve customer support models while minimizing associated risks and side effects. The banking sector is currently under-utilizing the potential of AI technology. Robo-advisers for investment advisory services, chatbots for customer support, and algorithmic engines for backend process automation are already in place in many banks. However, resolution tracking and advice management still largely depend on human operators. For a system to be fully reliable in a given domain, it must outperform human agents in that domain . This is particularly important in scenarios where good decisions are non-trivial and bad decisions can lead to catastrophic outcomes.

4. Case Studies

Digital Transformation in the Banking Sector: Current State and Future Directions examines how smarter business processes can be developed through the use of Generative Neural Networks (GNNs) and customer chat history. GNNs have the ability to build and train predictive models based on historical customer interaction data and generate realistic scenarios for process design, training, and what-if analysis. This approach demonstrates several advantages over traditional model-driven designs, including reduced reliance on domain expertise, the ability to discover unforeseen processes, and the capability to explore new designs through generative approaches. The banking domain is an ideal candidate for this method due to the availability of rich historical data on customer interactions and the strict compliance requirements for process design. The feasibility of

GNNs for business process design is illustrated through two use cases derived from a leading global bank, encompassing customer service within banking products and fraud investigation processes.

Fig 4: 8 Key Factors Driving Digital Transformation in the Banking Industry

Digital banking has gained significant momentum in recent years, driven in part by the COVID-19 pandemic. Traditional High Street banks have invested heavily in technology to facilitate online and mobile banking, resulting in a decrease in foot traffic in brick-and-mortar branches. Customers have become accustomed to a more seamless and user-friendly digital experience, similar to that offered by online retailers. In response, banks have embraced the concept of digital transformation, which involves rethinking existing processes and adopting new technologies to create enhanced customer experiences. As part of this transformation, banks must now design smart business processes that can adapt to changing circumstances and new regulations, particularly in customer service areas such as fraud detection, AML compliance, and product sales.

4.1. Successful Implementations in the Industry

Considering design recommendations for generative artificial intelligence and neural systems customer support models is vital for enhancing the quality of automated service models, especially in complaint resolution scenarios. Generative artificial intelligence has emerged as a market-leading artificial intelligence sector, with large language models at the forefront of generative neural systems. These models can comprehend and generate human language, offering significant potential for implementation in smart automated customer service systems. Recent advancements, particularly in open-source model development, are fostering competitive market solutions aimed at engaging customers and providing comprehensive automated services. Knowledge base creation approaches are also crucial for implementing competitive solutions in digital financial services.Automation is rapidly being integrated into customer service within the banking sector, utilizing chatbots and digital virtual assistants. This approach brings affordability, flexibility, and availability benefits. Limiting human contact is crucial for containing infectious disease spread during pandemics, leading to a preference for digital channels in financial service transactions. However, existing automation solutions often fail to meet customer satisfaction and complaint resolution needs. SAAS solution providers catering to the banking sector are encouraged to prioritize research and implementation of successful automated customer service models based on generative neural systems.

Equation 4 : Training a Generative Neural Network for Intelligent Customer Support

$$\mathcal{L} = \|x - \hat{x}\|^2$$

Where:

- x is the original input (customer query),
- $\hat{x}$ is the reconstructed output (generated response),
- The loss function minimizes the reconstruction error to generate relevant responses.

5. Conclusion

In the financial service area, generative AI systems will create new services such as personal finance managers, query generators and analyzers, investment managers, financial transaction agents, and even new financial instruments and services. New jobs will appear, such as training and maintaining generative AI systems. In the context of financial service customers, generative systems will keep records of collected data and metadata, applications, and digital financial services used, as well as all transactions and contracts concluded with analyzed digital financial services. This gathered knowledge will be used to create smarter and more sophisticated customers of financial digital services that will, ex-ante and ex-post, monitor the compliance of services with contracts, regulations,

and laws, protect the user from fraud and misuse of sensitivity data, analyze the quality of services given, and compare digital financial services.

Generative artificial intelligence models are emerging as a powerful and easy-to-use technology for performing a wide variety of tasks. New generative models behave as personal assistants and can create text, images, music, and video, and even generate whole new computer programs from a simple query. These models are having a profound impact on business and culture and will bring many new economically disruptive changes to society.

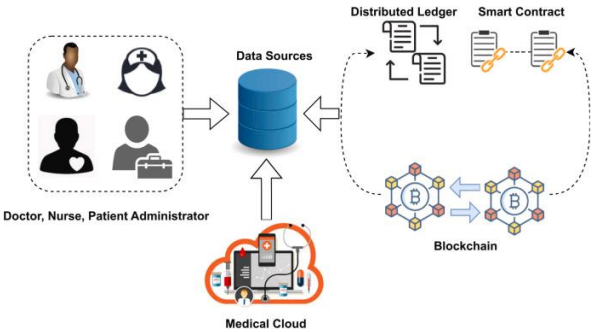

Fig 5: Blockchain for healthcare systems: Architecture, security challenges, trends and future directions

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5.1. Future Trends

Generative neural systems will enable chat and voicebots to cope with more complex customer questions without human support and predict future customer needs based on previous customer contacts. Consequently, chatbots will take over more responsibilities in customer support and proactive customer care. Digital financial service providers will widely apply smarter chatbots to reduce headcount costs in customer support. Since 2021, digital finance start-ups have struggled with falling profitability and rising interest rates due to the aggressive global monetary policy turnaround. Most digital banks are in the red, needing to lower costs. With the growing complexity of customer support models, maintaining highly skilled staff in customer support with university degrees is considered cost-intensive. It is more likely that considerations will arise to offshore less complex customer support or customer support in general to cheaper countries. Closed questions will be used to guide customers through the support process with chatbots in complex use cases. Nevertheless, customers with complex issues will be redirected to a human customer support agent. Natural language processing (NLP) and machine learning (ML)-based systems will still need to mature in financial services. Customer support technologies will vary widely among digital financial services providers, with some considered industry leaders. Generative neural systems and augmented intelligence will nurture a hybrid approach between fully automated solutions and human customer support. Broadly framed questions will need to be supported by human customer agents. As long as customers prefer natural language inputs over predefined answers, complex issues will need to be handled by human customer agents.

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