Primer on conversational interfaces

An exploration into financial services in emerging markets

Caribou Digital

Glossary

Application programming interface (API)[1]
Architecture so that one application can 'consume' capabilities or data from another application

Artificial intelligence (AI)[2]
Ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings.

Conversational interface (CI)
Any user interface that mimics chatting with a real human

Machine learning (ML)[3]
Field of computer science that gives computer systems the ability to "learn" (i.e., progressively improve performance on a specific task) with data, without being explicitly programmed

Natural language processing (NLP)[4]
Describes a machine's ability to ingest what is said to it, break it down, comprehend its meaning, determine appropriate action, and respond back in language the user will understand

[1] https://docs.apigee.com/api-platform/get-started/basic-concepts
[2] https://www.britannica.com/technology/artificial-intelligence

[3] https://en.wikipedia.org/wiki/Machine_learning
[4] https://chatbotslife.com/nlp-nlu-nlg-and-how-chatbots-work-dd7861dfc9df

Introduction
Why we wrote this

Much has been written about conversational interfaces - from the descriptive of what they are, to the practical on how to build them, to the theoretical on how people will rely on conversational interfaces in the future. Combing through this research, we felt that much of what has been written - different applications of AI, use cases for CIs, strengths of NLP - lacks relevance to the challenges implementers face when building CIs for emerging market users, particularly when CIs are tackling financial in

clusion issues. Moreover, much of what has been written about emerging market use cases fails to contextualize the opportunities with the realities on the ground, which include limited discretionary income, language constraints, and connectivity concerns.

This document aims to address these gaps by offering the following:

• Clarification: Many resources we reviewed confuse and conflate some of the terms used to describe conversational interfaces. This paper's goal is to clarify these terms by providing definitions and examples. This will provide a common foundation enabling our community of practice to relate to our analysis of emerging market financial service CIs.

• Application: The literature that does reference CIs in emerging markets does not adequately explore this context nor important implications for usage. To address that, and where relevant, this paper will offer a perspective on how CIs apply and relate to the emerging market context, in particular, implications for financial inclusion.

The primer—divided into two sections, architecture and use cases—will guide FiDA partners

and collaborators through the different terms and concepts associated with conversational interfaces using explanations and illustrations when appropriate.


Section 1

Conversational interface architecture and implications

History

Artificial Intelligence has been used to power conversational interfaces for decades. The first chatbot—ELIZA— could carry out conversations that seemed realistic, but in fact, ELIZA's responses were proprogrammed and canned or rephrased from previous inputs leveraging a few grammar rules.[5] Now, conversational interfaces are capable of being almost indistinguishable from a human. They have a personality, can understand human speech, and can perform a wide variety of tasks.

Over the past two decades, [timeline of interfaces below in Figure 1] advances in machine learning, natural language processing, applications program integration and computing algorithms have led to more sophisticated conversational interfaces that can mirror human speech and handle complex queries. Each of these topics will be explored in the next section.

1   Timeline of conversational interfaces[6]

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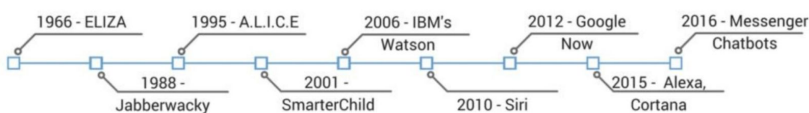
[5] https://en.wikipedia.org/wiki/History_of_artificial_intelligence#Deep_learning

Key technology contributing to CI development and emerging market implications

Definition: Machine learning (ML) is a field of computer science that gives computer systems the ability to "learn" (i.e., progressively improve performance on a specific task) with data, without being explicitly programmed[7]. Used in a variety of different services, from spam filtering to powering autonomous cars, machine learning can be simple to design for simple use cases or incredibly complicated for more complex needs. There are many different subcategories of ML that vary depending on how much data is available for reference, but all can be used to power how interactive the CI can be.

Emerging market implication:

Listed below are a subset of preconditions necessary to use ML, particularly when applied to CI:

1. Technical talent: Presence of engineers who are adept in using and applying machine learning techniques

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[6] https://www.altexsoft.com/blog/business/a-comprehensive-guide-to-chatbots-best-practices-for-building-conversational-interfaces/

[7] https://en.wikipedia.org/wiki/Machine_learning

2. Computing capacity: Direct or indirect [via cloud] computing power to data crunch large data sets

3. Availability of data: Access to large enough content data sets where the ML algorithm can source a response from [note: Presence of digital content in local languages influences how much data a CI can reference and source from when interacting with customers. So a CI in Western markets is likely to have more content to source from and respond with than a CI in more emerging markets]

As we apply these preconditions into the emerging market, we suspect there to be much variability between markets, particularly around technical talent and availability of data. Some markets (e.g., India) have a much more robust macroeconomic ecosystem that helps lay the groundwork for more complicated CIs vs other markets where the macro ecosystem is more nascent (e.g., Nigeria). We see this reflected in the types of financial services CIs available in these markets; using insurance products as an example, we have seen CIs in India assess customers financial health quickly and then seamlessly connect the customer to follow-up services to improve their financial health and/or access related products. We have yet to see this in more nascent markets within sub-Saharan Africa but have seen similar, albeit less complex, services emerge from South Africa.

Related, we also understand and recognize two micro related influencers that drive the look, design and complexity of CIs - natural language processing and computing tools. These are discussed in the next sections.
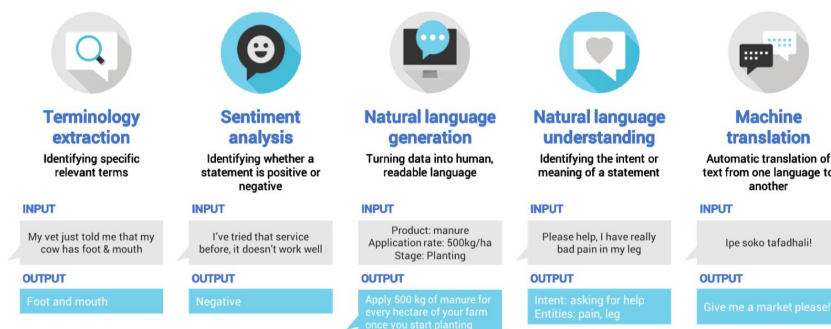
Natural language processing (NLP)

Definition: NLP describes a machine's ability to ingest what is said to it, break it down, comprehend its meaning, determine appropriate action, and respond back in language the user will understand[8]. Most commonly used by search engines to understand user queries, NLP is now used to improve the quality and integrity of a machine's response to customer queries over a conversational interface. To do so often requires using the latest in artificial intelligence technology where the computer program not only understands the meaning of each individual word but also understands syntax, sentiment and the context of an entire statement; illustrated below are some of the techniques involved in NLP[9].

Emerging market implications

Using ML for NLP can produce conversations between a machine and a human that mirrors the colloquial nature of a chat between two humans. This can be incredibly challenging given the inherent complexities with languages. As an example, imagine a customer uses the word 'lie' in a sentence. S/he could either mean to tell an untruth or to recline horizontally, which the machine needs to be able to differentiate based on the context of the statement. And in order to be truly conversational, the CI needs to understand idioms, allusions, hyperbole, synecdoche, and connotations—all which can vary geographically and even demographically[10].

2 Types of NLP

Terminology extraction	Sentiment analysis	Natural language generation	Natural language understanding	Machine translation
Identifying specific relevant terms	Identifying whether a statement is positive or negative	Turning data into human, readable language	Identifying the intent or meaning of a statement	Automatic translation of text from one language to another
INPUT	**INPUT**	**INPUT**	**INPUT**	**INPUT**
My vet just told me that my cow has foot & mouth	I've tried that service before, it doesn't work well	Product: manure Application rate: 500kg/ha Stage: Planting	Please help, I have really bad pain in my leg	Ipe soko tafadhali!
OUTPUT	**OUTPUT**	**OUTPUT**	**OUTPUT**	**OUTPUT**
Foot and mouth	Negative	Apply 500 kg of manure for every hectare of your farm once you start planting	Intent: asking for help Entities: pain, leg	Give me a market please!

[8] https://chatbotslife.com/nlp-nlu-nlg-and-how-chatbots-work-dd7861dfc9df

[9] Barrie, Georgia; Wills, Adam. "Conversational interfaces and the long tail of language". Accessed April, 2018.

[10] https://chatbotsmagazine.com/i-have-the-best-words-a-simple-explanation-of-nlp-in-chatbots-a9d408c76304

The challenges become significantly more complicated applying ML in emerging markets contexts. Listed below are three challenges we have noted:

1. Limited data: Building accurate machine translation for a language requires millions of validated translations, which is likely to be difficult for languages that are underrepresented on the Internet. However, the language could be translated by one of the large technology companies if there was enough commercial potential.

2. Code-mixing: Also considered hybridization, some of the languages integrate English, or another language, into its daily jargon. This code-mixing makes it challenging to build a large enough data set for these digitally underrepresented languages

3. Non-standard spelling of words: Due to a variety of reasons [low education levels, regional dialect differences, etc.], there is inconsistency with how words are spelled or how phrases are articulated

To maneuver around these challenges, some emerging market CIs interact with customers through a preprogrammed set of menu options rather than free form text. Though this makes the interaction less personal [and as a consequence, the lack of intimacy might prevent customers from sharing personal information when requested], it makes the interaction more accurate, conclusive and coherent for the customer.

Application Programming Interface (API)

Defined as the architecture so that one application can 'consume' capabilities or data from another application[11], APIs create the technical connection that allow two separate applications to integrate. So in the context of this primer, a third party CI can only connect with a messaging application offering an API which currently includes Skype, Telegram and Messenger. Whatsapp currently does not offer an open API but may do so in the future.

As explained by CGAP in their seminal Digital Rails document, digital financial service APIs fall into three categories:

1. Consent: Authenticate the account holder and consent (authorize) the third party to gain access to certain assets for that account holder. It is through consent APIs that customers give third parties permission to access their data or to move their money.

2. Payment: Enable variety of use cases from bill payments to bulk payments, merchant payments, and online payments

3. Data access: Enable third parties to access data on customers, agents, and even merchants to build out their solutions

Computational tools

Computational tools are the mathematical analyses used to power a CIs response to customer inquiries. Two of the many different tools used to power a CIs response to customer's questions are listed below:

- Pattern matches: Sometimes referred to as brute force, pattern matches are when the programmer describes every pattern for which there is a response. The brute-force mechanism is daunting: for each unique input a pattern must be available to specify a response[12]. It responds to anything solely because of an authored pattern, where parts of a conversation can be made to appear "natural" using a sufficiently large definition of patterns.

- Algorithms: As opposed to programming each query-response option, a programmer can build an equation that captures different behaviors. Based on what is required from the conversational interface (i.e., accuracy, model complexity, number of variables, features, etc...)[13], the equations driving the interface can be as simple as decision trees and linear regressions to something more complex like artificial neural networks and deep learning.

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[11] https://docs.apigee.com/api-platform/ get-started/basic-concepts

[12] https://medium.com/@gk_/how-chat-bots-work-dfff656a35e2

[13] http://datascience-africa.org/2016/07/ mathematics-machine-learning/

To capture how these apply into a conversational interface, we've assembled two illustrations of how a CI would manage one financial service hypothetical.

> **A user enters into a CI "What is the balance in my savings account?"**

Simplistic example:
Pattern matching, traditional programming techniques

Description: Using pattern matching, the CI would reference a large database that maps a user's input against a predefined set of words or phrases. So for this example, the CI would show the account balance if the user types in the above question, or a set of words or phrases pre-programmed to trigger the correct response.

Commentary:A CI using this technique can be created fairly simply without the need for machine learning but will likely face a few challenges. The ability to successfully match a user question against a predefined list often requires a long list of all of the different questions that need to be asked in all of the different syntaxes. This can be a mammoth task and so is rarely done from scratch. This technique is most effective in CI's with a very specific use case and therefore a limited set of likely user inputs.

Sophisticated example:
Natural language processing, machine learning

Description: Using natural language processing techniques, the CI would reference a list of possible 'intents' (e.g. "check balance", "top up balance", "send money") connected to a list of frequently asked questions (e.g. Input: "What is my account balance?", intent: check balance). When a user speaks or types a sentence, the algorithm will guess at the right intent based on how closely it matches the phrases it has learned from.

Commentary: CIs built on these techniques often use pre-existing code libraries or middleware to handle much of the natural language processing. While this can be an effective way to create sophisticated CIs, there are challenges, particularly in the developing world. Much of the available software for NLP is focused on Western languages and Westernised ways of speaking so a significant amount of customisation is often required. These algorithms also rely on probabilities to 'guess' the right answer. While this can work well in a customer service context, there are areas where this could prove risky (e.g. when making transactions).

Section 2
Use cases

Introduction

Irrespective of industry, conversational interfaces can provide three levels of interaction to the end user:

- Informational: Answer general support inquiries such as FAQs

- Transactional: Allow user to inquire and purchase goods and services

- Advisory: Offer tailored guidance and support on sector specific topics

We have seen CIs used to answer simple customer inquiries around banking services, assist in lead generation on banking products like insurance, and offer tailored investment and savings plans to interested customers. For most emerging market use, we have seen CIs designed to provide informational and transactional services but, due to ecosystem constraints, we have not seen any built around advisory.

In this section, we will look deeper into these different use cases using in-market products as illustrations.

Informational

Conversational interface providers—such as Teller, Finchatbot and Arifu—partner with financial institutions [banks, mobile network operators] that would like to improve their interactions with customers. These interactions, starting with customer service, offer a low cost but highly effective and efficient way to provide consistent support to commonly asked customer inquiries. The conversational interface, accessed over a messaging application or by sending a SMS to a short code,

often takes on a human persona to give the illusion of talking with an individual. Through either free form text or by selecting icons/photos, the user is able to interact with the conversational interface and ask it questions. If the conversational interface is unable to answer the question, it can hand the question off to a customer service representative.

Illustrated below is an example of a customer service inquiry to National Bank powered by Teller. Through NLP, the conversational interface is able to understand and accurately able to respond the user's inquiry. Additionally, the interface is able to understand shorthand ["Thx"] and to provide geo-located advice[location of a bank branch].

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3 Screenshot of informational focused CI
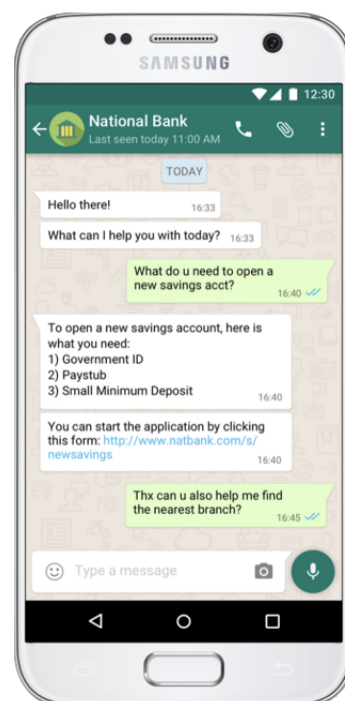
Benefits

To providers:

- Cost savings: FInancial institutions can reduce their customer support costs by using CIs to automate replies to basic and frequently asked questions.

- Optimize customer service: By freeing up customer service time away from answering basic and frequently asked questions, staff can instead focus their time toward handling more personalized and complex questions from customers

To customers:

- More thorough responses: As illustrated with the above example, the CI can help locate services closest to the customer while providing quick access to documents that would be much more difficult to navigate over the phone

- Quick and accurate responses: CI's respond to inquiries almost instantaneously and consistently, providing customers with timely and accurate information

Transactional

Conversational interface providers - such as Kudi.ai and Simply - use their interface to help customers transact [top up, bill pay, purchase insurance] over messaging applications. Users can either type in their request or select preselected buttons to interact with the conversational interface. With Kudi.ai, the user can send money/purchase airtime/pay bills by selecting through a menu of options, whereas with Simply, the user can chat with the interface through buttons to arrive at pricing for insurance products.

Benefits

To providers:

- Low cost lead generation: By guiding the customer through a sequence of pre-programmed and connected questions, the CI can understand user profiles to determine different price points for products [i.e., risk and demographic information used to determine price points for insurance] more cost effectively than using a sales representative

- Data generation: The CIs are effectively creating user profiles based on what services the customers use or through the responses they offer in product questionnaires. This data can be used in many

different ways, be it with improving the predictive or interactive quality of the CI, or through creating or expanding their product suite to better meet the needs of their customers

To customers:

- Quick response time: Similar to informational benefit, the customer can quickly get a quote and complete transaction on a product from A CI compared to obtaining one over the phone

- Low access fees: In countries where Facebook's free content offering - Free Basics - is offered, customers can access Messenger and its service for free. And because Messenger provides an open API, third party providers can build CIs on top of it. As a result, customers can use CIs to conduct different transactions free of service charge, as opposed to paying airtime/SMS fees to complete the transaction over a network.

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4 Screenshot of a transactional CI
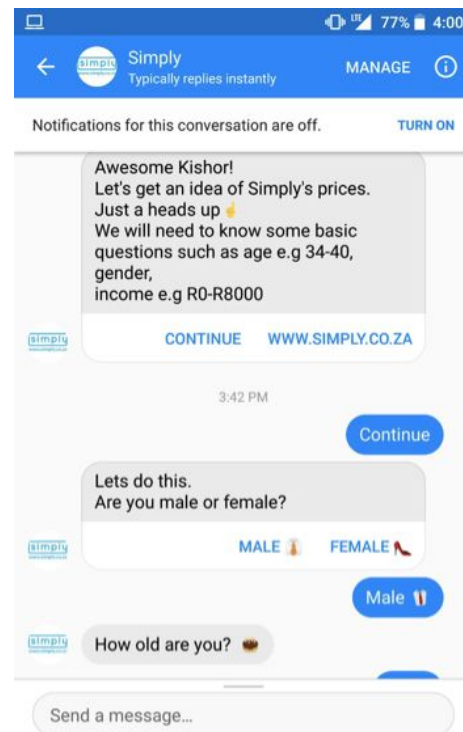
Advisory

Personal finance CIs, like Penny, engage in conversations with customers to provide tailored financial advice, from monitoring spend on categories, like food and entertainment, to educating customers about different investment vehicles to explore. In order to function, the user connects Penny access to their various banking services where Penny quickly learns financial behavior and can offer sound guidance and suggestions.

Benefits

To providers:

- Referrals and product upsell: Once the CI learns the customer's financial patterns and behavior, the application can quickly offer recommendations and suggestions to improve their financial hygiene - this can include suggestions on how to cut costs or recommendations with what investment/savings vehicles to look into.

To customers:

- Recognized financial advice: By monitoring consumption patterns, a advisory CI can provide tailored advice on what financial tools to use to manage costs against pre-determined and set financial goals at the customer's convenience rather than walking into a branch.

We have yet to discover a financial advisory CI made for the sub-Saharan African customer, likely influenced by the following factors:

- Limited data points to source from: Outside a few countries with robust mobile payments, there are not a lot of data points a CI, like Penny, could use to better understand user consumption patterns. The advisory CIs in more developed markets are able to pull from multiple services available, such as credit cards, bank accounts, investment and savings vehicles, to better understand spend patterns and provide recommendations and guidance

- Limited phone capacity: As of now, applications like Penny need to be downloaded and cannot be accessed over over third party messaging applications like Messenger [uncertain as to why but we suspect it is because of security and privacy concerns]. This poses a challenge to emerging market customers who may not have enough data space on their phone to access the service

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4 Screenshot of an advisory CI
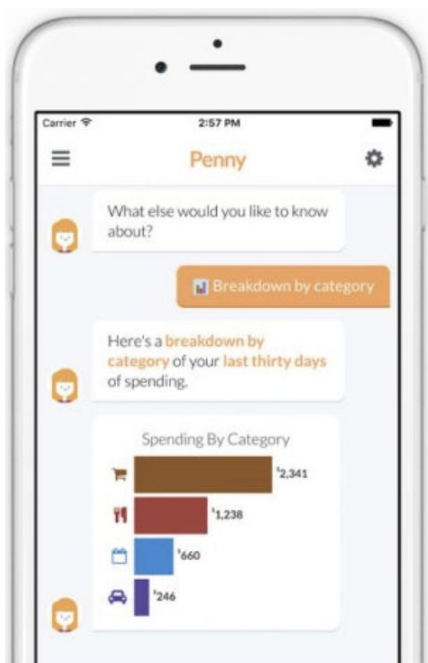
Conclusion

This primer is the first of three deliverables that are designed to help FiDA Partners better understand the potential for conversational interfaces to promote financial inclusion in emerging markets. This Primer is designed to provide a non-technical introduction to CIs and their application into financial services in emerging markets, which will improve the reader's working knowledge of CIs in general and in the context of emerging markets and financial inclusion.

We are currently developing two complementary resources on CIs:

- Landscape: We are creating a database that provides an overview of the different financial service CIs in sub-Saharan Africa, with one or two illustrative examples pulled in from other emerging markets as comparisons. Additionally, we will profile 3-5 different CIs to better illustrate their service offering and their use case in market through qualitative observations

- Business case: Under this umbrella, we will generate a series of sub-deliverables to offer functional and analytical guidance for stakeholders currently and potentially interested in working with or investing in CIs.

We believe this suite of deliverables will equip readers with the necessary background, tools and future state analyses to best understand the role and potential of CIs in financial inclusion.