SEMINAR - CHATBOTS IN BANKING

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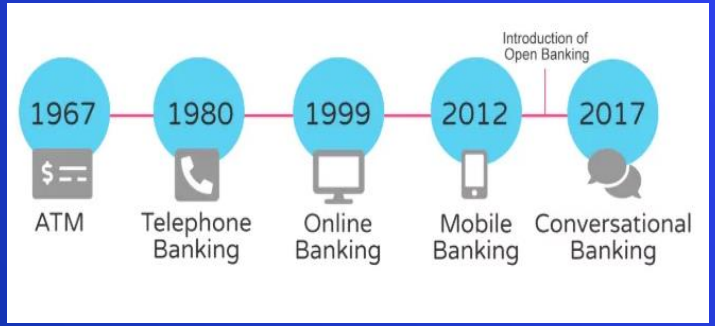
Introduction

- Covid 19 accelerated the digital banking momentum. In spite of rise in digital banking banks had not expected that they would not have face to face contact with customers for such an extended period of time. Social distancing changed the way people work and communicate and banks had to reduce their dependence on humans.
- The new wave of digital banking is all about customer experience.
- Banks must improve their customer service and provide scalable 24/7 customer support on multiple languages and channels. To achieve this objective robust platforms are required that can provide immediate assistance to customers for transferring money, checking account balances and other requests. Banks need intelligent platforms which will interact with customers and understand their needs. They require intelligent chatbots.



Literature Survey

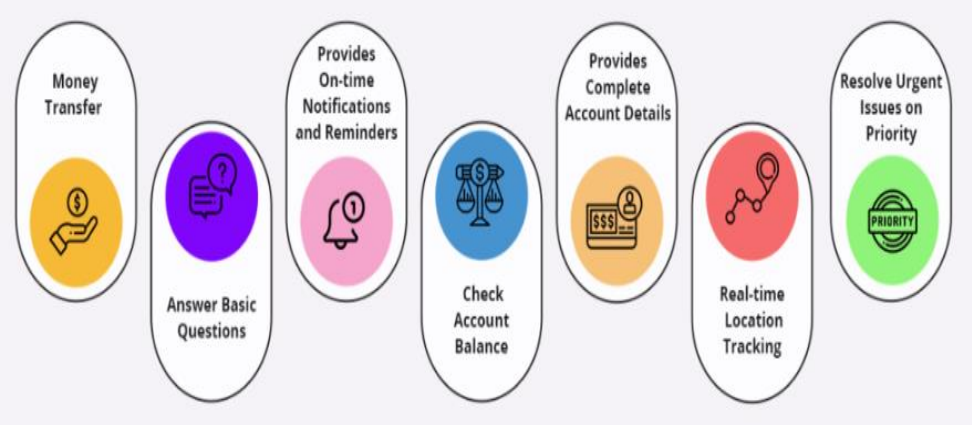
Banks play a very important role in the economic development of a country. The pandemic has changed the expectations of the customers from the banks. Customers now expect a personalized, speedy and easy medium of interaction with the banks for performing various financial operations. This has led to increase in the popularity of chatbots and other assistants which help in improving the customer experience.

Today chatbots are used by many financial organizations all over the world and still a lot of growth in their usage is expected. These assistants help the banks in automating a lot of repetitive and time consuming jobs which are performed by customer support teams. They also act as a listening channel for the banks. This helps banks in understanding user habits, predict customer actions and deliver personalized offers and services. There are mainly three different kinds of chatbots available-1.Rule based chatbots, 2. AI based chatbots and 3.hybrid chatbots (that use NLP but are less sophisticated than AI chatbots). The architecture of all these types has been discussed in detail with their examples.

There are many benefits of chatbots both for the customers and for the banks. Some existing banking chatbots are mentioned along with the future scope of chatbots in banking.

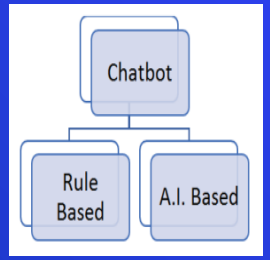
Use cases of chatbots in banking

- Reviewing account information checking balance, applying for different products and services
- Creating personalized alerts for upcoming bill payments
- Alerting users about suspicious activity or large money transfers
- Handling customer service complaints
- Answer common and location specific questions in a personalized way



Types of Chatbots

There are 2 main types of chatbots: rule based and AI based



Rule based chatbots-consist of simple systems and have limited responses. The program scans and decides keywords and responds with the appropriate command typed by the user input. Rule-based chatbots do not respond when they encounter unfamiliar commands and unrecognised phrases.

AI based chatbots-These chatbots are equipped with an artificial brain. They can understand open ended queries. Different NLP techniques are applied for processing the text submitted by the user. The grammar is checked and information is extracted out of it. This information is analysed and an appropriate response is generated for the query. These bots keep expanding their data base by learning from people's conversations and interactions.

Hybrid chatbots-They are a combination of simple(rule based) and AI based chatbots.

Rule based Chatbots

- Example of Rule based approach of designing a chatbot is Alice Chatbot system which was developed by Richard Wallace and it uses AIML language.
- **Artificial Intelligence Markup Language (AIML)**

  AIML is a subset of the Markup language (XML)
- AIML's building block is the **category**. Each **category contains a question-answer** or input-response pair The set of all categories makes the chatbot Knowledge Base**.** Categories are made up of patterns and templates.
- The **pattern** tag defines a possible **user input**. The **template** tag sets the **chatbot response** for a certain user input
- **The Alice Chat Bot System**
- *It uses AIML* as the language for defining patterns for queries and its answers.
- AIML comprises of data items called AIML objects that contain **topics** and **categories.**
- The principle of matching pattern strategy is based on finding the shortest, best match between patterns
- <aiml> tag marks the start and end of a AIML document
- The **topic** is an additional item at the top level and has a name attribute and a **collection of similar categories**

```
<aiml>
<topic name= "topic" >
<category>
  <pattern> ...(Your question)</pattern>
   <template> (Answer to the question)</template>
</category>
      ....
</topic>
</aiml>
```

```
<category>
  <pattern> Hello *</pattern>
   <template>
   <random>
       <li>Hello!</li>
       <li>Hi! Happy to meet you!</li>
       <li>Hi! Hope you are doing great!</li>
       <li>Hi! What's up? Hope you are doing great!</li>
    </random>
</template>
</category>
```

<that> stores last response

<random> gives random responses from a list of responses.

```
<category>
  <pattern> What about the rate of interest ?</pattern>
   <template>Do you like increase in rate of interest?</template>
</category>
<category>
   <pattern>YES</pattern>
    <that>What about increase in rate of interest?</that>
     <template> Even I prefer increase in the rate of interest. Good for customers right?!</template>
</category>
```

AI based chatbots

- AI **chatbots** are programs that simulate human-like conversations using **natural language processing** (NLP). AI chatbots are becoming increasingly valuable to organizations for automating business processes such as **customer service**, sales, and human resources.
- An example of NLP based assistant is IBM's Watson. Another example of a chatbot in banking domain is **alVin.**
- LV= is a company in the banking sector in UK. Its Broker division provides various commercial and personal line products for third-party brokers. The chatbot **was** built and trained with information about LV= Broker's products. It offers live chat service to customers. It also helps with transactional tasks and is also used to connect to customer service representatives in case of complex scenarios.

Components of an AI Chatbot

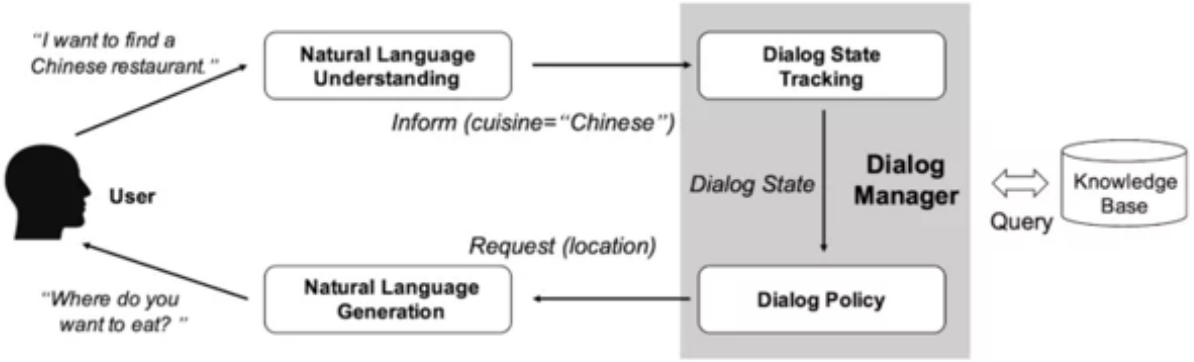


Fig 3.4.1. AI chatbot components

Natural Language Generation- It is the conversion of machine produced structured data into text that is readable by the user.

Natural Language Generation has these steps-

- Content Determination-Knowledge base is filtered to choose the response.
- Data interpretation-Data is interpreted, patterns are identified and put into context.
- Document structuring- Narrative structure chosen based on the type of data.
- Sentence aggregation-Relevant sentences or phrases are combined to summarize the topic
- Grammatical structuring-Program deduces syntactical structure of sentence and then rewrites sentence in grammatically correct manner.
- Language Presentation-Final output is generated based on the template chosen by the user

- **Data Storage**: The conversations held by the chatbot with the customers are stored for further training and testing of the chatbot. They are stored in structured form on cloud or physically.
- **Knowledge Base:** It is the information that the chatbot relies on to respond to users. Different businesses require different kinds of knowledge base. Here the knowledge base will contain all the customers' financial information and information about the bank that the chatbot will display to the answers asked by the customers.
- **User Interface:** The front-end of a chatbot which is used for conversing with the user. The chatbots can be integrated into different messaging platforms, such as WhatsApp, Slack, and Facebook Messenger etc.

Design and Architecture of NLP based Banking chatbot

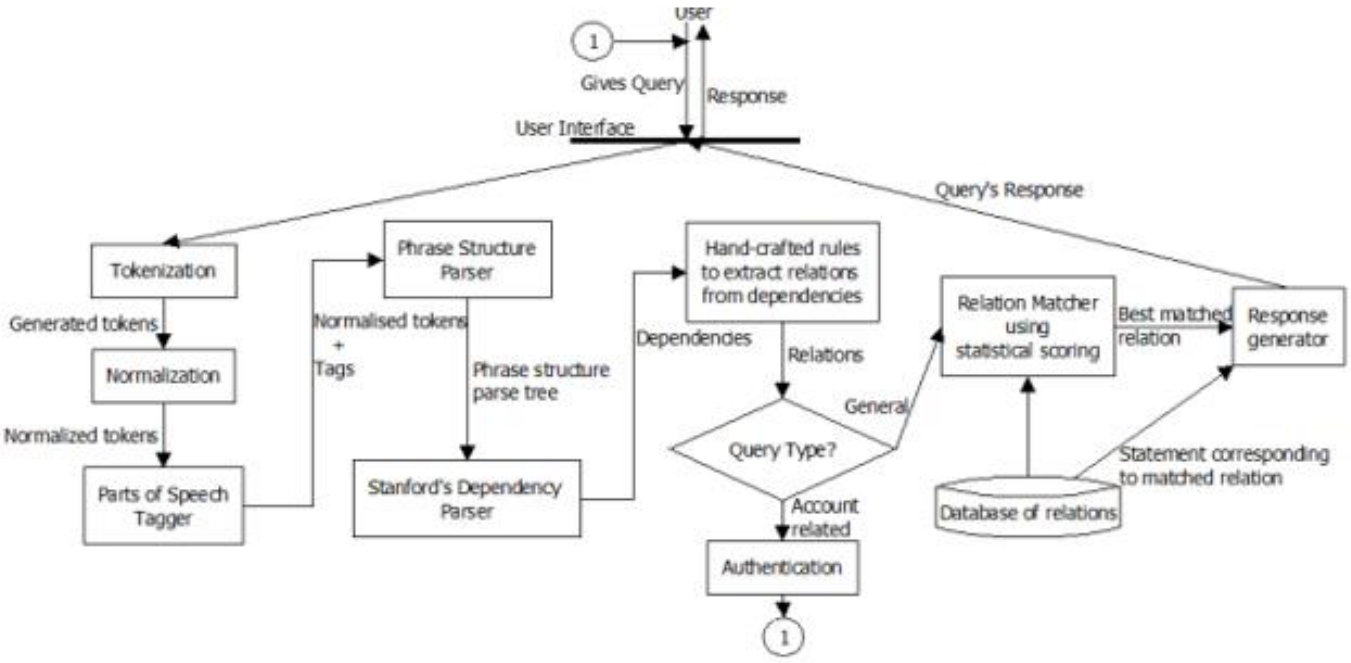


Fig 3.5.1. Architecture of Banking assistant using NLP

In the architecture for banking assistant several modules are involved.

- **User interface:** Here the user enters his / her query and submits it to the banking chatbot for processing

- **After submitting the query Tokenizer is involved. The** *tokenizer splits the query using delimiters and generates useful tokens. The delimiter include space, or comma or semi-colon, etc.*

- **The tokens thus generated are sent to the Normalizer Here pre-processing is done on the tokens which involves**

1. **correcting the spelling of words**(using Damerau-Levenshtein distance

[***Damerau–Levenshtein distance*** *is a string metric used for measuring the edit distance between two sequences.]*

2. **expanding of acronyms and abbreviations** (by looking into a database of common acronyms and abbreviations)

3**. conversion of tokens to standard format** (e.g. all characters in lowercase)

- **The normalized words are sent to a Parts of Speech (POS) Tagger Here meaningful labels will be assigned to these words.**

- Let us understand this with an example.

- Suppose the sentence is: “The bank provides 8% interest on fixed deposit.” **Here output from POS Tagger is “The/DT bank/NN provides/VBZ 8/CD %/NN interest/NN on/IN fixed/VBN deposit/NN ./.”**

[Here DT=determinant/article, NN=noun(singular), VBZ=Verb third person singular, CD=cardinal digit, IN=preposition VBN=verb past participle]

part-of-speech tagging, also called grammatical tagging is the process of marking up a word in a text as corresponding to a particular part of speech, based on both its definition and its context.

Part of speech tagging is performed by a software called as the part of speech tagger

- **The output is given to a Phrase Structure Parser**

A parser is used to check whether a language follows a pre-defined syntax. Parser takes input in the form of sequence of tokens and produces output in the form of parse tree.

In case of natural language, it's very difficult to define a standard grammar as there will be large number of syntactic rules. A limited number of rules will be used and probability will be used as a measure to determine the best parse for a sentence.

The grammar must be a Probabilistic Context-free Grammar (PCFG). A probabilistic context-free grammar G can be defined by

G = (M, T, R, S, P)

M = set of non terminal symbols **R = set of production rules** **S = start symbol**

T= set of terminal symbols **P = set of probabilities on production rules**

A parse tree or derivation tree is an ordered, rooted tree that represents the syntactic structure of a string according to some context-free grammar)

In our example the parse tree obtained will be

```
(ROOT
  (S
    (NP (DT The) (NN bank))
    (VP (VBZ provides)
      (NP
        (ADJP (CD 8) (NN %))
        (NN interest))
      (PP (IN on)
        (NP (VBN fixed) (NN deposit))))
    (. .)))
```

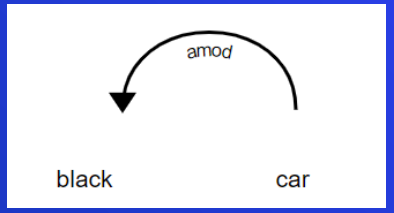
Here
S=sentence **NP**=Noun Phrase **DT**=Determinant/article **NN**= Noun (singular) **VP**=Verb phrase **ADJP**=Adjective Phrase **CD**=cardinal Digit **PP**=prepositional phrase **IN**=preposition/subordinating conjunction **VBN**= verb past participle

The parse tree obtained from parser is then given to a dependency parser which will convert the phrase structure rules into dependencies

Dependency Parsing - It is the process to analyze the grammatical structure in a sentence and find out related words as well as the type of the relationship between them. Each relationship has one head and a dependent that modifies the head. And each relationship is labelled according to the nature of the dependency between the head and the dependent. These labels can be found at Universal Dependency Relations.

In this diagram, there is a relationship between car *and* black *because* black *modifies the meaning of* car

car *acts as the* ***head*** *and* black *is a* ***dependent*** *of the head*



the nature of relationship is amod. amod=Adjectival modifier

The Dependency Parser from Stanford's API is preferred for dependency parsing. [Stanford CoreNLP parser is used to perform dependency parsing. The parser supports a number of languages, including English, Chinese, German, and Arabic.]

In our example the output will be

here det(bank-2, The-1) indicates “bank” is dependent on “The” by the relation “det” i.e. determiner

det(bank-2, The-1)
nsubj(provides-3, bank-2)
root(ROOT-0, provides-3)
compound(%-5, 8-4)
amod(interest-6, %-5)
dobj(provides-3, interest-6)
case(deposit-9, on-7)
amod(deposit-9, fixed-8)
nmod(provides-3, deposit-9)

dependencies help in relation extraction by following some hand-written rules for extracting useful relational information from the dependencies

we can find the following relations from input dependencies:

subject is bank, object is interest ,characteristic is fixed deposit, action is provides and quantity is 8% interest

After obtaining the relations, analysis is made **to categorize the obtained query** which is in the form of relations into an appropriate type.The types are **Account related** and **General queries.** This is essential as Account related information should be confidential. Two authentication is done so that only the legitimate users can access such information.

Then the relations are sent to a **Relation Matcher**. It tries to **match the query relation with the relations in a database to find any matching answers.** The database consists of relations mapped to their respective natural language sentences. A simple matching algorithm is for matching purpose:

Algorithm 1: Relation matching

1. Let $< A_i, R_i, B_i >$ be a set of relations for $i = 1$ *to* k in the database.
2. Let $< P_j, S_j, Q_j >$ be a set of input query relations for $j = 1$ *to* m
3. Initialize $score = 0$
4. *for* $i = 1$ *to* k
   for $j = 1$ *to* m
   if $A_i = P_j$ *and* $R_i = S_j$ *and* $B_i = Q_j$, *then*
   Add 10 *to score*
   else if $A_i = P_j$ *and* $R_i = S_j$, *then*
   Add 5 *to score*
   else if $R_i = S_j$ *and* $B_i = Q_j$, *then*
   Add 10 *to score*
   else if $A_i = P_j$ *or* $B_i = Q_j$, *then*
   Add 2 *to score*
   endfor
   endfor
5. *return score*
6. end

The matcher's output will be the sentence that references to a relation with highest score. The relation output will determine the natural language sentence that will be given as output to the user as a response.

Some Examples of Currently available chatbots

Erica from Bank of America- Erica has seen an exponential growth in its usage from 2019 to 2022 and has answered about 250 million questions. Some features of Erica are allowing a user to view balances across all accounts, locate past transactions across a consumer's accounts, monitor recurring charges, receive bill reminders when payments are scheduled to be made and review weekly updates on monthly spending.

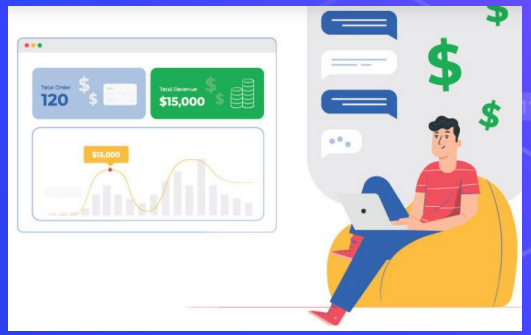
Ally Assist from Ally Bank- Ally Assist was one of the oldest chatbots that was launched in 2015 by the Ally Bank. Ally assist is available in voice and text mode and helps a user understand a transaction in detail and it provides a wide range of services to the customer. Ally Assist is also available on iPads and tablets and has surveyed that one third of the bank's customers are using mobile banking regularly.

Amex bot from American Express-Amex bot' works on the bank's app and Facebook Messenger. Now American Express is adding a contextual and predictive search capability inside its app. Contextual search is gaining popularity in the field of NLP. Apart from all the basic features available in chatbots, this searching ability would be added to the bot. This search feature will try to understand scenarios and predict what a customer needs before he/she types anything on the basis of real time location and scenario tracking. Also in case a user opens a search after noticing duplicate transactions, it can determine they're mostly interested in claiming a credit card transaction.

HDFC'S EVA- HDFC Bank's EVA has been the first AI banking bot in India. EVA was launched in 2017.It has answered more than five million queries from customers. Customers can get a personalized digital banking experience with EVA.EVA was built by Senseforth AI Research Private Limited, startup working on research in conversational banking.

Future of chatbots in banking

- Though conversational banking has come a long way, a lot needs to be achieved.
- Today most banks have chatbots which are able to perform the basic operations related to giving information about various products and services offered by the bank and perform simple transactions and operations. Very few chatbots are currently able to provide advanced artificial intelligence to offer predictive insights. Also chatbots in banking have still not become very task oriented and a lot of banking tasks could still be automated. There is a lot of scope for research in the field of architecture of chatbots used in banking. But with emerging trends in AI and NLP, there are predictions that chatbots will be much more commonly used. In future, chatbots will be predict human behaviour with higher accuracy and use this for self-learning. Voice bots are also gaining popularity these days and expect a lot of growth in their usage.



Thank you!