INDIAN
INSTITUTE OF
TECHNOLOGY
ROORKEE

TIMESPRO

Intelligent Chat Bot for the Banking Sector

A Dissertation Submitted for the
Post Graduate Certificate Programme in
Data Science and Machine Learning
(Batch 07)

DECLARATION

I hereby declare that the thesis is my original work and it has been written by me in its entirety. I have duly acknowledged all the sources of information which have been used in the thesis. This thesis has also not been submitted for any degree/Certificate in any university/Institute previously.

Student Name: Rakesh Kumar Pandey

Signature of the Student & Date

ABSTRACT

Customer Service is the most important part of the growing business. It is nothing but have the one-on-one communication between the consumer and the organization while introducing their products. Most of the businesses believe making connections with customers at their best level will guide the customers to bind with the same organization. Since most of the customers are not aware about how to proceed with the self-engagement, more manpower and the customer relationship management has become a must. Due to that reason a little mistake can hamper the organization name if the customer service went wrong.

Since this is the digital era, communication platforms with novel concepts of machine learning and artificial intelligence are rapidly growing. With advanced digital technologies related to machine learning and artificial intelligence, managing customer service has become easy, reliable and cost effective rather than applying human resources.

As a solution an AI assistant can be proposed: which can be used to avoid the disadvantages caused by human engagement as customer care employees. The AI assistant is nothing but a chatbot which helps the customers to inquire about the issues they are facing without having human interaction. Within the whole scenario the organization is considered as a bank. The importance of having an AI assistant is because organizations need to deliver more convenient communication mechanism that support 24-hour customer service, consistent answering, diminish the customer waiting time and instant communication. To achieve those goals organization able to develop their own Artificial Intelligence based assistant to cater their customers. AI assistant will enhance the productivity of bank staff, save overall costs, and maximize the customer engagement.

The banking AI assistant is responsible for responding to the customer's needs. To fulfill this requirement, first of all the customers should send their queries to the AI assistant. Once it is done, the AI assistant will identify the user's requirement and respond accordingly for the trained queries. Moreover, it will identify the misspelled user queries and respond to them within an approximate level. Other than that, AI assistant has the capability of providing answers

which has lower possibility of being accurate with the graceful fallbacks according to the user queries. Even for the out of scope queries it responds intuitively.

INTRODUCTION

Banking is a major part of our day today life. Building up savings, drawing salaries, paying utility bills, borrowing loans all involve transactions with the Bank. All the businesses relying on the banking sector since they handle their financial transactions such as day to day deposits/ withdrawals, investments, business expansions plan to name a few.

But if we have any banking related queries, we have to visit the bank or contact customer care. This consumes a considerable amount of time and effort from both parties, especially for the bank. Huge amount of phone calls regarding customer inquiries are attended by the bank staff daily regarding Loans, Fixed Deposits, Exchange rates, Leasing, Pawning etc. lack of staff and heavy workload per employee sometimes result in unattended customer inquiries and delays in assisting the customer. Therefore, it will be more convenient if customers have a proper way of communicating with the bank via online process and get the feedback within a short period of time.

Motivation

To overcome this particular issue, a chat bot which is capable of assisting customers with accurate information instantly will be very useful and convenient for both customers and the banking sector. Customers can directly communicate with the chatbot, and they can receive answers to their bank related queries. Also, the bank can reduce their customer query phone calls by using a chat bot which they can assist customers with accurate and updated information.

Statement of the problem

Problem is that find any financial information regarding Commercial Banks are not very pleasant at the moment. For an example, if we want any information about a loan scheme either we must physically visit the bank or contact customer care. Therefore, developing a proper chatbot that can Process Natural Language (NLP), find highest convenient answer to user's question and answer more human friendly way to the user's question is the final goal of this thesis.

Research Aims and Objectives

Aim and objective of this thesis is to implement and evaluate AI based chatbot that can process Natural Language in the banking domain.

Aim

Aim of this project is to implement an Artificial Intelligence banking assistant to answer banking related customer queries and diminish customer inquiry calls to the bank staff. Without waiting in a queue, customers can have answers to their queries or get assistance and nevertheless bank staff can use their valuable time to enhance their productivity.

Objectives

Implementing and evaluating user friendly banking chatbot is the objective of this thesis. And to achieve this objective,

- **Round the clock support**- Increasingly digital always-on consumers are expected 24-hour customer service. Customers are more likely to be attracted and retained if a chatbot is integrated into the bank's website.
- **Enhanced productivity of bank personnel**- Banking chatbot can make bank personnel more productive by allowing them the freedom to focus on more complex problems instead of being stuck with basic customer queries.
- **More convenient mode of communication**- Younger generation prefer instant messaging and it is faster than waiting in a queue to get assisted by a staff member.
- **Consistent answers**- Chatbot maintain consistency in answering user queries and this ensures value to customer conversation. Consistent answers will always improve customer experience with the bank.

Scope

Scope of this research is to develop a chatbot that can serve customers via bank website and Slack. When chatbot built into the bank website have a competitive advantage and more importantly can have attention from interested people. And this chatbot has to answer Current,

Savings and Fixed Deposit related queries. Most of the time customers have queries related to the bank products. Therefore, chatbot has to assist customers on product related queries. These customer queries need to receive via textual format as well as responds need to show as textual format. Chatbot has to simulate human conversation. To give better experience to the customer, chatbot needs to maintain smooth conversation flow and maintain polite responses when answering doubtful queries. Answers have to be highly relevant to the user's queries.

LITERATURE REVIEW

This chapter provides essential background information referring to chatbot projects. Most importantly in this chapter discover the history of chatbot, recent chatbot projects and chatbot frameworks available.

History

ELIZA

In 1964 Joseph Weizenbaum developed a Natural Language Processing Computer program called ELIZA at MIT Artificial Intelligence Laboratory (Weizenbaum, 1966). ELIZA was one of the world's first chat bot programs. To simulate conversation, ELIZA employs pattern matching and replacement techniques. However, there is no built-in framework for contextualizing events in this program. ELIZA was built in MAD-SLIP, which allows to analyze user inputs and carry on a conversation based on the constrains given in the SCRIPTS. ELIZA uses keyword matching, which implies that the program will look for keywords that match the input. If matching keywords are identified, the system will generate a suitable response based on the criteria specified for this keyword, and if not, a related remark will be recalled. As a result, ELIZA does not always grasp the problem or the user's input; instead, ELIZA just matches the user's input with her regular responses.

ALICE

Artificial Linguistic Internet Computer Entity (ALICE) is a Natural Language Processing chatbot which can proceed conversations by responding as natural as possible("A Closer Look at Chatbot ALICE," n.d.; "AliceBot," n.d.) . Richard Wallace developed ALICE in 1995. ALICE can use a fallback system using linguistic deflection. ALICE stores its knowledge about English conversation patterns in AIML files (Artificial Intelligence Markup Language). AIML files contain data objects called AIML objects, that can divide as topics and categories. The topics have a name attribute and a set of categories related to this specific topic, while categories refer to the basic unit of knowledge in AIML. Each category has a pattern and a template as well as a guideline for aligning the user's input to the desired result.

Related work

Banking Chatbot on Turkish

Yapi kredi Technology's developed a Hybrid Approach to question answering for a banking chatbot on Turkish (Dündar et al., 2018). Specialty of this research is they have proposed hybrid key word- word embedding based question answering method. This will calculate similarity between two questions and similar words are stored in the database using clustering. Word embeddings are used to get semantic similarities between synonyms. Using synonymous they can identify the most relevant words in the bag of words. Queries and dataset are matched, and performance has been increased compared to methods that do not utilize keywords. But when handling morphologically rich languages need to expand the keyword database farther.

AI Hotel Booking

Researchers at the University of Toronto developed a Real-world conversational AI system for hotel booking (Li et al., 2019). They have used a frame-based dialogue management system that integrates with NLP. Drawback is that more complex queries need to be handled by human. And also, deep learning models are memory intensive and it's important to share memory across different models when the system expands in the future.

AllenNLP

Allen Institute for Artificial Intelligence developed a Deep Semantic Natural Language Platform (Gardner et al., 2018). AllenNLP platform that addresses issues with easy-to-use command-line tools, declarative configuration-driven experiments, and modular NLP abstractions. This will allow researchers to focus on the high-level summary of their models rather than the details.

Bidirectional RNN and Attention model

Bajaj Institute of Technology developed an Intelligent chatbot using deep learning with Bidirectional RNN and attention model (Dhyani and Kumar, 2020). Bidirectional Recurrent Neural Network contain attention layers is used, so that input sentences with large number of tokens can be replied with more appropriate conversations. This is an open domain chatbot that can develop for a particular domain by training with the domain knowledge.

Emotionally Realistic Chatbot Framework

Researchers of Bina Nusantara University designed an Emotionally Realistic chatbot framework to Enhance Its believability with AIML and Information states ("Designing an Emotionally Realistic Chatbot Framework to Enhance Its Believability with AIML and Information States," 2019). Main focus of the research is Understanding a natural conversation and replying and keeping the conversation flowing naturally.

Chatbot Frameworks

Google's Dialogflow

Dialogflow is a google owned natural language understanding AI platform that makes conversational user interface into devices in many different contexts ("Dialogflow Documentation," n.d.). Such as mobile apps, bots, interactive voice response systems. Dialogglow that uses Natural language processing NLP, actions on Google and Google cloud platform that expose artificial intelligence and machine learning methods such as natural language methods such as natural language understanding (Chinnapa Reddy Kanakanti and Sabitha R., 2020). Dialogflow provide multiple types of input from users including voice and text inputs and also Dialogflow can respond them in either through text or with synthetic speech. Dialogflow introduce two different services, Dialogflow CX provide an advanced agent and Dialogflow ES provide the slandered agent. Dialogflow CX capable to customize and improve performance and accuracy of the response.

Microsoft LUIS

Microsoft Language Understanding Intelligent Service (LUIS) is a cloud based conversational AI service that provides custom machine learning to a user's conversational, natural language text to predict overall meaning, and pull out relevant detailed information (aahill, n.d.). LUIS provides enterprise ready custom models that continuously improve conversational ability. With LUIS, developers without machine learning expertise can quickly build and use language understanding models specific to their tasks (Williams et al., 2015). but there are some limitations with the customization.

Amazon's Lex

Lex is a conversational interface building service introduced by Amazon, and it will integrate with any application and be able to use voice and text as inputs (What Is Amazon Lex? - Amazon Lex). Lex provides the advanced deep learning functionalities of Automatic Speech Recognition (ASR) for converting speech to text and Natural Language Understanding (NLU) to recognize the intent of the text to enable to build applications with highly engaging user experiences and lifelike conversational interactions. **Developing of a voice chatbot for payment using Lex service with Eyowo as the Payment platform** (Samuel et al., 2020). The voice chatbot system will provide an alternative means of engaging in financial transactions just by speaking, thereby fostering innovations in the technology industry, this will be done by using Amazon Lex and Lambda function, alongside the use of a payment platform called Eyowo, in resolving all financial matters.

IBM Watson

Watson is a question answering computer system capable of answering questions posed in natural language, that developed by IBM's DeepQA project by a research team (IBM, 2020). Watson Assistant provides users with consistent and accurate answers across any device, channel, or application. Using Artificial Intelligence, Watson Assistant learns from user conversations, and improving capabilities. **Practicing value innovation through artificial intelligence** (Russo-Spena et al., 2019). This article focuses on the value innovation prompted by artificial intelligence. By shifting the attention from innovation as a new outcome to innovating as something that people do to co-create value. Detecting how multiple actors connect, interact, learn and discover new ways to do things, serve others better and co-create value through AI.

Rasa

Rasa is an open source framework for developing AI powered, industrial grade chatbots ("Open source conversational AI," 2020). **An analytical study and review of open source chatbot framework** (Sharma, 2020). Rasa can interact with both voice-based and text-based conversations also able to develop chatbots to different platforms and channels. Speciality of the platform is providing infrastructure and tools necessary for high performing, resilient, proprietary contextual assistants that work. Rasa's NLU provides developers with the technology to understand messages, determine intent, and capture key contextual information. Framework

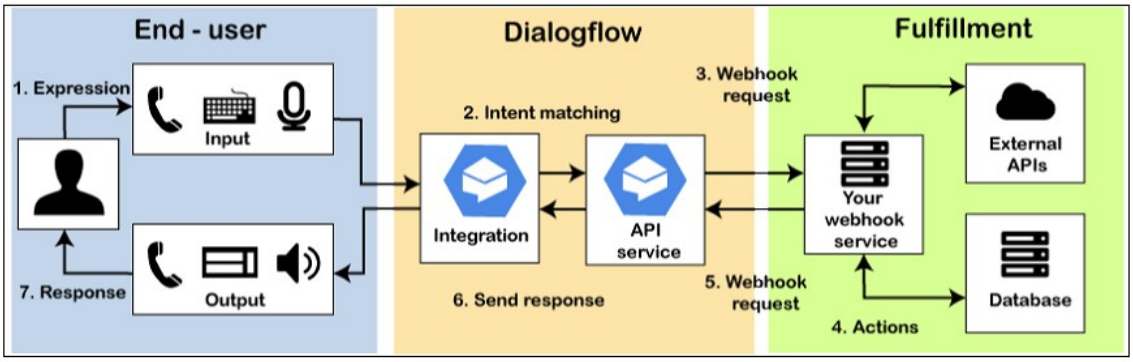
supports multiple languages, single and multiple intents also both pre trained and custom entities with more control. Rasa's Dialogue management is able to hold meaningful conversations with user's multi step conversations that remember context and integrate business logic. And also, it learns interactively from real conversations. Rasa focuses on flexible architecture not on straight out of the box software because it is necessary for great conversational AI.

METHODOLOGY

In this section, we will cover some general principles, methods and approaches that were used throughout the entire Google dialogflow based banking assistant implementation.

Chatbot Architecture

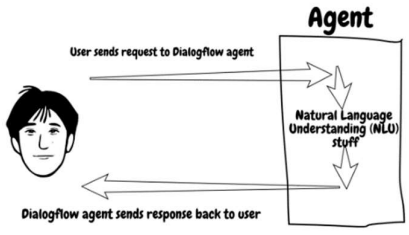
Dialogflow is a natural language understanding (NLU) platform developed by Google that allows developers to build conversational interfaces such as chatbots and voice-activated applications. The architecture of Dialogflow is designed to facilitate the creation of intelligent and interactive conversational agents. Here's an overview of Dialogflow's architecture:



User Interaction

Users interact with the chatbot through various channels, such as websites, mobile apps, or messaging platforms like Facebook Messenger or Slack.

Dialogflow supports multiple input methods, including text, voice, and rich media.



Agent

In Dialogflow, an agent is the core component that processes user input and generates responses.

The agent is trained using predefined intents, entities, and a machine learning model to understand and respond to user queries effectively.

Developers can design and customize the agent's behavior using the Dialogflow Console or API.

Intents

Intents represent the mapping between what a user says and what action should be taken by the chatbot.

Dialogflow provides a set of predefined system intents for common tasks, and developers can create custom intents tailored to their application's needs.

Each intent may have training phrases that help the model recognize user input.

Entities

Entities are used to extract specific information or parameters from user input.

Dialogflow offers both system entities (e.g., date, time, location) and custom entities that developers define for their specific use cases.

Contexts

Contexts provide a way to maintain state and context in a conversation.

They help the chatbot understand the user's intent in the context of the ongoing conversation, enabling more natural and coherent interactions.

Fulfillment

Fulfillment allows developers to integrate external services or APIs to fulfill user requests.

Dialogflow sends webhook requests to fulfillment services, enabling dynamic and personalized responses beyond predefined intents.

Integration

Dialogflow integrates with various channels and platforms through its built-in integrations or API.

Popular integrations include Google Assistant, Facebook Messenger, Slack, and more.

Natural Language Processing (NLP)

Dialogflow's NLP engine processes user input using machine learning algorithms to understand the semantics and context of the conversation.

It handles tasks like language understanding, intent recognition, and entity extraction.

Dialogflow Console

The Dialogflow Console is a web-based interface where developers design, configure, and test their chatbots.

It provides a visual representation of the agent's intents, entities, and settings.

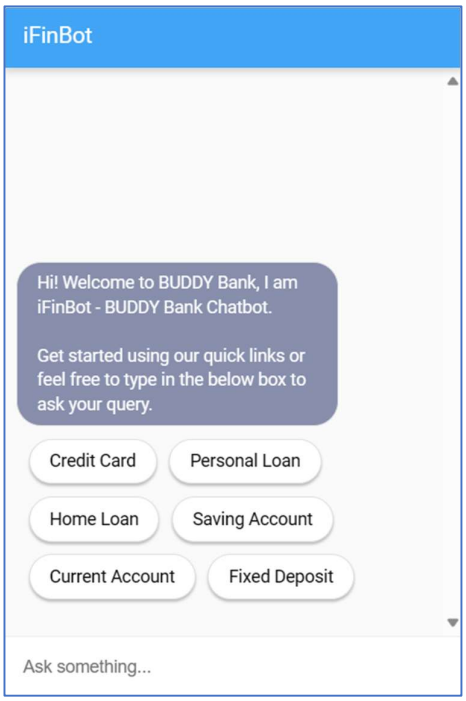
In summary, Dialogflow's architecture is centered around creating conversational agents that can understand and respond to user input in a natural and context-aware manner. The combination of intents, entities, contexts, and fulfillment services empowers developers to build powerful and interactive chatbot applications.

Exploring Chatbot Capabilities: A Comprehensive Review with Screenshot

For the purpose of demonstration and review, I have deployed the chatbot live on the website http://buddybankcapston.in/ (buddybankcapston.in). The home page is depicted in the following illustration.

One can initiate the chatbot by clicking on the chatbot icon located in the bottom right corner of the homepage.

Default Welcome Message



Git Link: https://github.com/innodata/buddybank/tree/main

Home Page: http://buddybankcapston.in