

An Overview of the Necessary Technologies and Implementation of an AI based Help Desk

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A help desk is a platform used to maintain a huge customer base along with maintaining the goodwill of the company among the customers. Identification of the various issues and solutions, ways to fix the issues, customer feedback, along with the problems arising while the IT vendors are trying to develop solutions becomes easier and feasible. Managing all the requests sent to the help desk is a tedious task for the developers and the managers of the help desk due to the heavy flow of incoming queries. Thus, we have proposed a solution which automates this process and minimizes the processing time and resources for incoming requests. The solution uses an Artificial Intelligence (AI) based chatbot, which would be hosted on the company's website and an email automation system. All the primary customer queries like basic product information would be handled by the chatbot at the company's website level which will reduce the load on the email system. All the incoming emails would be answered in a systematic, real time manner by the email automation system. We have also built a User Interface (UI) where all the email logs would be visible to the concerned authorities, which provides them a complete authority over the functioning of the system. Thus, this solution provides a consistent way to reduce human costs that incur to the company and aims at targeting maximum customer satisfaction using applications of Artificial Intelligence, Natural Language Understanding (NLU), Natural Language Processing (NLP), Optical Character Recognition (OCR) etc.

Keywords: AI, Help desk, Chatbot, Email, Python, OCR, Database

1 Introduction

Along with important factors like quality of a product or service, security of data, etc. the success of every industry is also dependent upon a good customer support system. The Customer network handling team or Help Desk of a company receives a variety of queries or enquiry mails per day. Handling all these mails manually may be a tough job. Thus automation of the Customer Support System is the need of the hour. Artificial Intelligence is a widely emerging technology which helps in the automation of such a system and thus reducing manual work. Also, it is always preferred by a customer if all the product or service related queries are solved by the company immediately, which may not always be feasible. Thus we require a system which interacts with the customer sort of a human and which is out there 24x7. This could be achieved with the assistance of an Artificial Intelligence based chatbot which might be hosted on the company website and made available to the customers at all times to unravel their issues or assist them in any way required.

2 Literature survey

Authors Prof. Firoz Khan, Srigowri. V. B, Swetha K M, Syeda Ayesha and Vinutha K [1] show the implementation of an AI voice bot with the help of which people can book train tickets online using textual as well as voice commands. To achieve this, they have proposed the use of AIML with program-o and Google voice synthesizer for creating a speech recognition system and for natural language processing. Their suggested system bot engine has the following components: 1) Kernel 2) AIML Parser 3) Utility Manager 4) Word Substitution 5) Pattern Manager. Following steps are used to process the user input in the chatbot: 1) Speech to text conversion using the middleware api if input is in the form of voice 2) If the input at the Middleware is in text format, it is passed to the pattern matching algorithm which runs the AIML scripts. 3) If a matching pattern is found, the corresponding template is sent back to the middleware. 4) The middleware then transforms the template in JSON format and sends it to the android app. 5) The app decodes the JSON response and sends the response to the user. The limitation of this system is that the chat bot replies to only those questions to which there are answers in its dataset.

Authors Junmai Zhong and William Li [2] have developed a convolutional neural network (CNN)-based supervised learning model that helps in classifying the customer calls of an auto dealership business into four classes of intents : sales, service, vendor, or jobseeker. Their proposed call intent prediction system has four main elements: 1) Collection of transcript data of the phone calls from the database 2) Labeling the observed data as training, validation, and testing examples, and utilizing their domain knowledge about call intent from the transcripts of the caller channel, that are collected by utilizing the scalable data labeling method 3) Using natural language processing (NLP) algorithms for tokenization of the document and representation of embedded vector of the words 4) multi-class text classification model training for call intent prediction using the CNN algorithm. The Word2Vec or GloVe techniques are used for effective word embeddings. The results of the experiments performed by them show that the CNN algorithm with sufficient training data gives state-of-the-art prediction performance.

Anran Jiao [3] in his paper explains the practical framework and introduces the principle of RASA NLU for the Chatbot system, then it integrates RASA NLU and neural network (NN) strategies and implements the system by performing entity extraction after intent recognition. It explains the principle of Rasa NLU, strategies of entity extraction like Rasa NLU technique and Neural Networks technique and analyses the system by analyzing intent recognition and entity extraction. It builds a bot that gives information about stocks; The general steps are summarized as following: (1) Send a message to the financial chatbot; (2) Sentences are analyzed and entities are returned by RASA NLU; (3) iex-finance API gives information about stocks; (4) Possible intent of the message chatbot, received by regular expression and keywords is returned; (5) Response to the message is given according to the intents and current states based on the state machine.

Authors Tom Bocklisch, Joey Faulkner, Nick Pawlawski, Alan Nichol [4] in their paper introduce a combination of tools, Rasa NLU and Rasa Core. These are open source python libraries for building conversational software. The paper explains the basic concept of Rasa and the basic terminologies like 1. Architecture - This consists of the following steps - Message in, Interpreter, Tracker, Policy, Action, Message out. 2. Actions - Rasa Core predicts which action to take from a predefined list at each iteration. An action can be a simple utterance, or it can be an arbitrary function to execute. 3. Natural language understanding. 4. Policies - The job of a policy is to select the next action to execute given the tracker object. It further explains the training data formats which can be either a json format or a markdown format. It also explains the concept of Machine teaching which is supported by Rasa Core - where developers correct the actions made by the machine and visualization of Dialogue Graphs.

Pragaash Ponnusamy, Alireza Roshan Ghias, Chenlei Guo, Ruhi Sarikaya [5] have created a conversational chat-bot. They have described it to be feedback based and hence it is self-learning as well. They have improved the accuracy of the bot without the need of manually transcribing and annotating the data. They studied the queries of the users, previously modified queries for fixing the error in their previous attempts or some improperly formulated queries (such as a part of the title of the song). Thus, errors are detected by the self-learning system automatically, reevaluations are brought about, and the runtime system is fixed which is used to rectify different types of errors existing in different units of the system. As a collaborative filtering mechanism to mine the patterns in the queries, they have proposed to leverage an absorbing Markov Chain model. Their approach is highly scalable. The proposed system attains a win/loss ratio of 11.8 reduces the defect rate by more than 30% efficiently.

Kyoko Sugisaki [6] describes a Chat Bot Kit in this paper. It is a web based tool for chats based on text messages. This has been designed for research purposes in computer-mediated communication (CMC). This enabled him to carry out language studies on the text based and real time chats. The language performance of data, that is, when the keyboard strokes are not happening, their rhythm and their speed, and also the movement of the mouse has been measured. Quasi-synchronous and synchronous modes of chat communication are provided by this tool. He has also proposed a Wizard of Oz approach. In this, a researcher acts as a computer during a conversation with a human test subject. The human is told how to talk with the computer. This is also used in studies in Human-Computer Interaction (HCI) and for the assessment of chatbots (dialogue systems) in Natural Language Processing (NLP).

Authors Aishwarya Gupta, Divya Hathwar and Anupama Vijayakumar [7] introduce us to the various definitions of a chatbot and its need in the modern era. The AI chatbots have been generalized into different types and then described in the paper. Three main types of chatbots are - Menu/ Button based chatbots, Keyword-Recognition based chatbots and Contextual chatbots. The quality of user experience is the most contextual, then comes keyword recognition and then comes menu based. The paper also describes the most popular chatbots available in the market namely - Humorist Chatbot System, Dorothy Network Management Chatbot, Adaptive Modular Architecture based chatbot and Web-based voice chatbot. The paper provides good insight into the current scenario of different chatbots.

Akshay Kumar, Pankaj Kumar Meena, Debi Prasanna Panda and Ms. Sangeetha [8] start by describing Artificial Intelligence Markup Language (AIML) and Latent Semantic Analysis (LSA) which are used in the development of chatbots. They further conduct their own literature survey by considering papers such as 'Chatbots: Are They Really Useful?', 'A Web-based Platform for Collection of Human Chatbot Interactions', 'The anatomy of ALICE' and others. By referring to this data they propose their own interactive chatbot using the Flask framework in Python. They intend to follow the steps such as - 1) Simple welcome questions by the bot 2) AIML script check 3) AIML categorization and 4) Answering the query. The paper successfully implements the working of an interactive chatbot. However, the chatbot fails to communicate in a natural fashion which needs to be improved in the future.

Authors K. Shanmugalingam, N. Chandrasekara, C. Hindle, G. Fernando and C. Gunawardhana [9] have proposed a hybrid method with two approaches-a)Manual handling b)Automated System. Manual handling is for queries that cannot be automated. Mails are classified as -1)Quick fixes 2)First mail 3) Forwarded mail. Quick fixes are handled by training a Microsoft LUIS framework. First time mails are cleaned, OCR texts are obtained from attachments, categories are assigned and then they are passed to the LUIS framework. LUIS question and answer support handle forwarded mail directly. The email classifier feature uses the following steps: 1)Preprocessing 2)Feature Selection 3)Machine Learning approach 4)Deep Learning approach 5)Threshold Selection. Here Randomforest, XGBoost, LSTM, BidirectionalLSTM with embeddings were examined with varied input features.Out of these,Bidirectional LSTM with word embedding techniques were executed with thresholding techniques for better accuracy of the model. The different technologies used are Microsoft LUIS , Microsoft OCR , Machine Learning algorithms, Artificial Neural network model LSTM.The major drawback of this paper is that only sixty one percent of the incoming mails are handled accurately.

3 Technical comparison

Sr. No	Title and year	Authors	Techniques used	Gaps
1	Artificial Intelligence based Travel Bot, 2018	Prof. Firoz Khan, Shrigowri. V. B , Swetha K M , Syeda Ayesha, Vinutha K	AIML with program-o, Google voice for NLP	The chatbot is capable of answering only those questions to which there are answers in its dataset.
2	Predicting customer call intent by analyzing phone call transcripts based on cnn for multi-class classification, 2019	Junmei Zhong and William Li	CNN- based supervised learning classification model, GloVe and Word2Vec NLP algorithms	Authors assume that the calls can be classified into only four categories: sales, service, vendor or jobseeker. Also large datasets are required to train the model to get the correct predictions.
3	An Intelligent Chatbot System Based on Entity Extraction Using RASA NLU and Neural Network, 2020	Anran Jiao	RASA NLU, NN.	Doesn't explain the details of implementation.
4	Open Source Language Understanding and Dialogue Management, 2017	Tom Bocklisch, Joey Faulkner, Nick Pawlawski, Alan Nichol	RASA NLU, RASA CORE, Different Python libraries.	Very basic implementation, does not explain the details.

5	Feedback-based self-learning in large-scale conversational ai agents, 2019	Pragaash Ponnusamy, Alireza Roshan Ghias, Chenlei Guo, and Ruhi Sarikaya	Self learning and feedback based chatbot, Markov model, transition graphs.	Although the win/loss ratio is good, it can be improved.
6	A web-based tool to simulate text-based interactions between humans and with computers, 2019	Kyoko Sugisaki	Research based paper	No implementation, only propositions.
7	Introduction to AI Chatbots, 2020	Aishwarya Gupta, Divya Hathwar, Anupama Vijayakumar	Research based paper	No implementation as such
8	Chatbot in Python, 2019	Akshay Kumar, Pankaj Kumar Meena, Debiprasanna Panda, Ms. Sangeetha	AIML, LSA, Python, Flask	Chatbot fails to communicate in a natural fashion which needs to be improved in the future
9	Corporate IT-support Help-Desk ProcessHybrid-Automation Solution with MachineLearning Approach, 2019	K. Shanmugalingam, N. Chandrasekara, C. Hindle, G. Fernando and C. Gunawardhana	Microsoft LUIS, Microsoft OCR, Machine Learning algorithms, Artificial Neural network model LSTM	ML model handles 61 percentage of incoming emails correctly

4 Abbreviations

AI: Artificial Intelligence
 ML: Machine Learning
 NLU: Natural Language Understanding
 NLP: Natural Language Processing
 NN: Neural Networks
 OCR: Optical Character Recognition
 XGBoost: eXtreme Gradient Boosting
 LSTM: Long short-term memory
 LUIS: Language Understanding Intelligent Service

further asks some more questions, analyses the responses and repeats this process till the user is satisfied. The conversation comes to an end after the user says bye.

The conversational flow helps in understanding the effectiveness of the communication between the chatbot and the user. This is represented by the screenshot of our actual chatbot implementation below.



Fig 1.3: UI screenshot of chatbot implementation

- **EMAIL**

The email part of the helpdesk deals with automatic responses to the queries asked via mails. It reads the mail body, analyzes it and responds with the most suitable answer. Multiple technologies are put together to build a platform that aims to solve email queries. A few technologies used are:

Python: Programming language Python is used as the primary backend technology to read and respond to the incoming mails. Inbuilt python libraries are used to read the mail body, subject and sender of the mail, further abuse the mail body, categorize the mail and respond to the mail with a suitable and most appropriate response.

Important python libraries needed:

1. imaplib: is an email retrieval protocol that just reads the mails and displays them. It includes python's client side library called imaplib. It is used for accessing emails over imap protocol.
2. smtplib: Simple Mail Transfer Protocol (SMTP) is used for sending emails via the internet. Python's smtplib is a library used to create an SMTP connection at the client side to send emails programmatically.
3. Optical Character Recognition: this technique is used to convert images of typed, handwritten or printed text into machine encoded text from a scanned document or an image. Python's Optical Character Recognition library tesseract is mainly used for this purpose.

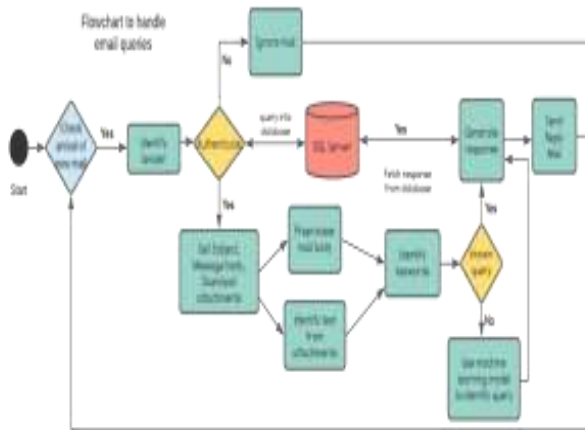


Fig 1.2: Flowchart of automatic email responder system

The system monitors the arrival of new mails. On arrival it identifies the sender of the mail using python’s map library and authenticates the user, authentication uses a database, if it is a valid user, then the contents and subject of the mail are retrieved and attachments are downloaded. The retrieved mail body is then preprocessed using python tools and libraries. Optical character recognition is one of the main technologies used in the system, it converts images of types, handwritten and printed text into machine encoded text from the document. Tesseractocr is used for this processing.

In the next step, according to the results of the preprocessing, the mail is classified into of the following categories - ERROR, SALES, HELPDESK and MISCELLANEOUS and then forwarded to the concerned team, along with it a generic response is also sent to the sender of the mail.

6 Conclusion

The conversational flowcharts for all the main categories of data were created for proper understanding of the possible chatbot conversations. The first level of conversational flows for the chatbot were implemented. A generic email responder system which replies to any unread mail with a default response is created. A basic GUI is created to display email logs for the concerned authorities. OCR is implemented along with basic classification techniques for the emails.

7 Acknowledgement

We would like to thank our guide Mrs Varsha Pimprale for motivating us to write this paper and our college for giving us the opportunity to choose this project.

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