Magic Bot Architecture Patent

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1 Abstract

2 Introduction

3 Advanced ChatBot Architecture

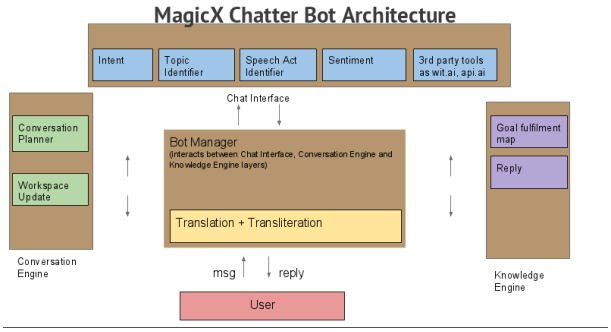

Figure 1: Overall architecture of the bot.

4 Chat Interface

This component of the bot basically get message from the user in raw format and converts into structured data format by extraction information hidden in the message such as intent, topic, speech acts, sentiments, etc.

4.1 Topic Identifier

The topic identifier is a LDA based tagger that tags a message with appropriate topic and score. LDA identifies topics within text by allocating words with certain weightage to each topic. Table 1 shows how LDA distributed words to each topic.

4.1.1 Hidden topic

A score above a predetermined threshold is considered correct topic for the message. But there are certain messages which are agnostic to topic. So we developed an algorithm called hidden topic to handle agnostic messages.

The theory behind hidden intent is that it assumes if the customer is in a flow it continues to be in the flow unless there is a substantial change in score of classification. This score can be heuristically set for each category. In the conversation 2 we see that category was retained as travel and tickets until the score was very high when it was changed to utility and bills.

In the figure 2 we demonstrate how our algorithm implements topic change in a crisper way. The hidden topic model has been demonstrated through figure 3.

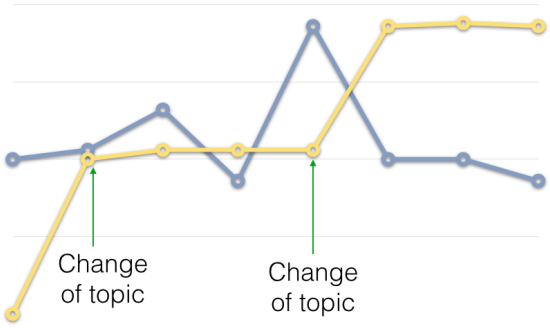

Figure 2: Comparison of score given by classifier alone and classifier + hidden topic algorithm.

4.2 Intent

Every message from customer is treated equivalently. This is our key assumption. Any message can contain intent, name, email-id, places, etc. The first step is to extract names, places, emails, etc. from the message. Whatever is left can be an empty string or it may contain some intent. To get the intent, we categorise the statement based on a Naive Bayes classifier

Topic no.	Topic words
1	order delivery place runner rs deliver address confirm delivered cost minutes charges biryani price noted chicken details food charge
2	bangalore give address assist moment check road kindly information hyderabad revert nagar details location contact noted patience main minutes
3	payment bill pay amount send number link discount kindly give make offer moment recharge rs electricity account offers online
4	id slot book service time tomorrow laundry wash today email assist flat iron rate give pm response pleasure ahead
5	check give time today moment call don ur ll vendor inconvenience day team revert assist plz person good information
6	kindly response give awaiting tickets moment pm today city movie ticket book check assist time email date booking location
7	rs full facial wax discount normal beauty pedicure hair services service spa slot book cost lotus waxing manicure half
8	city back request services service leave offline beauty provide tiger magic food hyderabad inform awaiting assist response full massage

Table 1: Example conversation with variation of last_Score and current_score. This is the output of conversation after implementing hidden topic algorithm

Message	last_Score	last_topic	current_score	current_topic
hi	0.0	NA	0.5	beauty services
Please book a ticket	0.5	beauty services	0.53	travel and tickets
From Bangalore to Mumbai	0.53	travel and tickets	0.66	beauty services
26th Jan 5:30 pm	0.53	travel and tickets	0.43	beauty services
recharge phone	0.53	travel and tickets	0.93	utility and bills
9108367124	0.93	utility and bills	0.5	beauty services
Rs 10	0.93	utility and bills	0.5	beauty services
I am done	0.93	utility and bills	0.43	grocery and gourmet

Table 2: Example conversation with variation of last_Score and current_score. This is the output of conversation after implementing hidden topic algorithm

into one of the categories like food, travel, utilities, beauty-services, etc based on services provided by our company. Then we obtain the intent and the sub-category of the message. For example:- "I want to order chicken biryani". Here intent is 'order' and sub-category is 'chicken biryani'. We provide a score how likely is our classification.

Intents could be - Buy, Sell, Deliver, Book, Reserve, Pay etc. They are the action part of the message which informs the bot what he/she desires to do.

4.3 Speech Act Identifier

We have tagged conversation in six categories of speech acts. The theory of speech act is that each speech has an action which in turn gives a key information of how the reply should be. The types of speech acts are defined as follows based on Searle's illocutionary speech act :-

The Assertive Speech Act(As): The utterance states a true fact about some state of the world pertaining to the context of the conversation and all involved participants commit to its veracity.

The Directive Speech Act(Di): The utterance that serves as a request, com- mand, advice, or instruction from one participant to another in terms of a specific action pertaining to the context of the conversation.

The Commissive Speech Act(Co): The utterance that serves as a commitment or promise to a future course of action that will change the state of the world pertaining to the context of the conversation by a participant, and all other participants commit to it's veracity.

The Expressive Speech Act(Ex):The utterance expresses some emotion or attitude about the context of the conversation. For example, the emotion could be gratitude, regret, excuse, etc.

The Declarative Speech Act(De): The utterance causes the state of the world to change, with full implicit or explicit acknowledgement of the participants

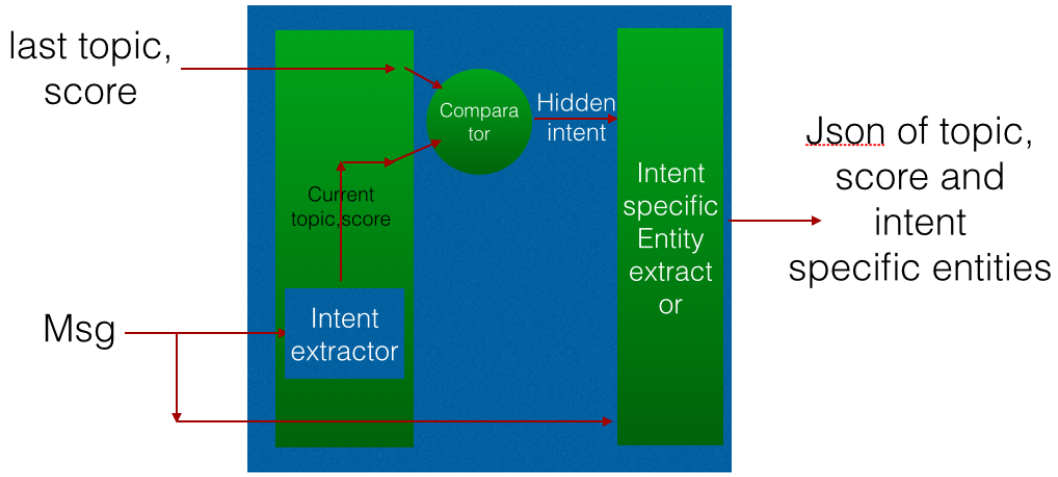

Figure 3: Flow Diagram of the hidden topic algorithm.

of the conversation .

The GoalFulfillment Speech Act(Gf): The utterance causes the state of the conversation to reach a conclusion, when all the issues raised in the conversation have been resolved and acknowledged by the participants of the conversation.

These speech acts have been demonstrated in 3.This data is trained and the classifier takes a sentence and then produces respective speech act.

4.4 Sentiment Analysis

We have used Textblob to classify sentences into positive, negative and neutral sentiment and also generate a score of how intense is its sentiment.

5 Bot Manager

Bot manager is the central piece of the entire architecture. It recieves the input and then decides the flow of message. First it directs the message towards chat interface then conversation engine and finally knowledge engine. The reply generated from the knowledge is passed on to the user via the Bot Manager. So it is the incharge of the entire architecture. It is also the interface between all the pieces of the architecture.

5.1 Contextual translation

Bot Manager also has a translation piece where it understands the language of the incoming message and translates it into english so that other parts of model can understand the message.

6 Conversation Engine

Currently we assume one of the possible solutions be it a recharge or laundry. But in reality we should assume multiple solutions because conversation might take a turn in a vicious way. The key is to know that conversation belongs to one of the types - Procedural, Informational, Dispute Resolution, TroubleShooting. Each conversation will have a different state machine. Depending on the requirement of user, we have multiple goal fulfilment maps ready and the reply is made probabilistically. In the workspace we keep the current states of each solution. Based on a scoring mechanism, we either remove or keep a solution. Finally there will be only one or no(in the case of dissatisfactory conversations) solution in the workspace. This is how human agents work in real conversations and even AI should try to replicate that.

6.1 Conversation Planner

Conversation planner guides the state machine depending on the speech act assosciated with each incoming message. It initiates the workspace where it assumes that there are 4 solutions or type of conversation - procedural, informational, trouble-shooting, dispute resolution. Each solution has a state diagram which starts with greeting state and ends with satisfaction state or completion state. There is a dissatisfaction state which terminates the chat abruptly. Conversation planner moves each solution through the state diagram. If there is a valid transition defined in the state diagram, the solution gets a positive

Conversation	Speech act
Customer : 1chicken biryani, 1kabab, 4kulchas,1 butter chicken	De
Customer : Your there	De
Customer : I need from nandhini	De
Customer : Sure	Ex
Customer: Ya tell me	Di
Customer : When will I receive	Co
Customer: Oops this is sad	As
Customer : Thanks	Gf

Table 3: Example conversation with messages from customer and correspinding speech acts

score of 3 else is given a negative score of 1. Then the flow transfer to a module called Update Workspace.

6.2 Update Workspace

Update Workspace will remove a solution if it attains a score less than 0 or the second maximum score is less than $\frac{1}{3}^{rd}$ of the maximum score in which case only the solution with maximum score is retained. After sufficient iteration either there is only one solution left in the workspace or there are no solutions in which case the chat is abruptly ended or transferred to a human being.

7 Knowledge Engine

Knowledge engine contains a set of goal fulfilment maps(gfm). The gfms are specialised chatbots whether food and bevearage or laundry.

So the topic identifier and type of chat is used to identify the gfm. Once the gfm is identified chat is transferred to the gfm which handles conversation in the manner of a finite state machine. Once the fsm completes the routine, Chat switches back to Bot Manager. A typical gfm looks like a flowchart as shown in fig 4. As we can see

7.1 Goal fulfilment machine

It is essentially a hashmap that has a hash function to identify the chatbot which will takeover once the topic of chat and type of chat has been identified. So it has a list of topics and the 4 categories of chat + a greeting and a conclusion chatbot. In all if there are n topics the hashmap will have n*6 gfms.

7.2 Reply

For every message the chat interface knows the speech acts and hence it can modify the type of reply it will give. It also has a list of entities to be filled. If it is a recharge bot it will require entities like number, recharge amount, etc. Until it gets these information it has to make the user elicit information in a structured manner. This structure comes from the entity list. Using the entity list and the number of items to be filled, next question is automatically generated using natural language generation. One of the techniques used for NLG is AIML which can generate random replies for similar query. A structured query is fed to AIML which then generates a query in natural language. AIML also supports multi language. So bot can be designed to be multi-lingual which is of great use in a country like India where people speak several languages other than english.

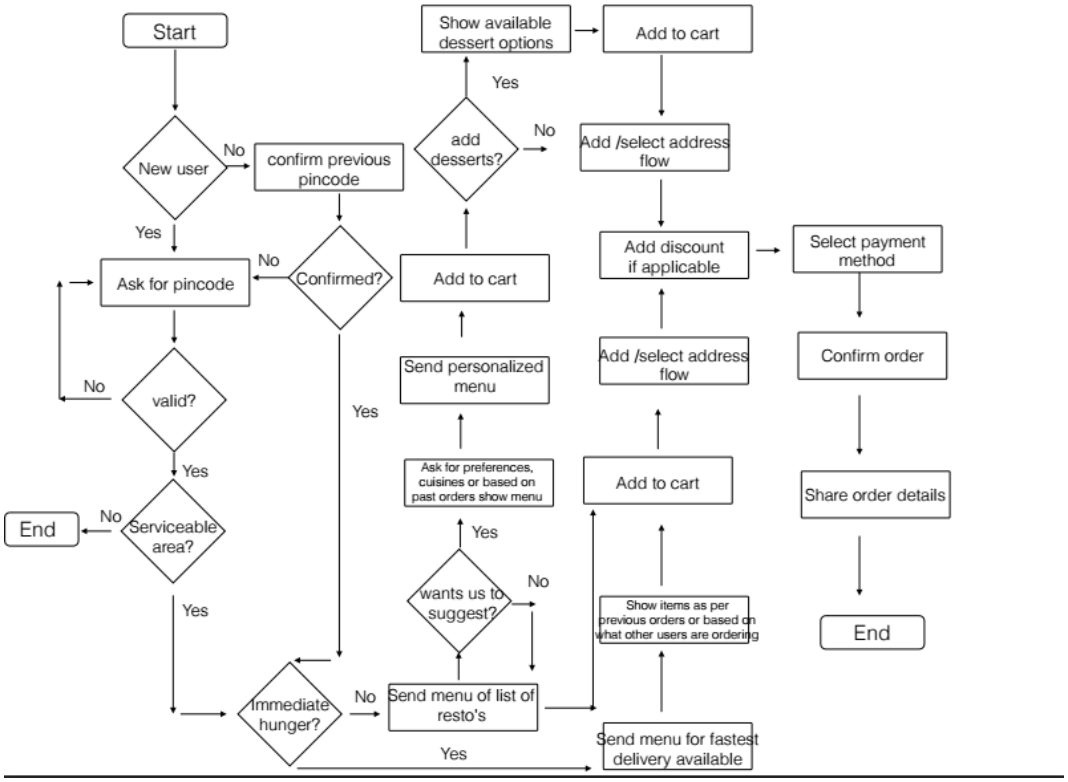

Figure 4: Gfm of a food flow.