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Multi-Agent Communication System with Chatbots

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ABSTRACT

It has been found that communication is actually important in our lives; without it is difficult to accomplish something. It becomes possible with the support of the technology that is being used today; now it is easy to communicate as faster and much easier. A type of an agent called Chatbot is a conversational agent or a special kind of a program which had been specifically designed to replicate an intelligent chat with a single or multiple human users by using auditory or text based techniques. Chatbots are become an innovative application of industrial and research domains which specifically represent human to machine interaction systems. In technical perspective, efficacy of chatbots can be enhanced by designing multi-agent communication system using novel mechanisms. Although our study focuses on building chatbots that sustain agents in collaborative learning by interacting with one or more chat agents. The proposed research is based on client server chatbots so that they will be capable to communicate by sending and receiving questions and responses. In this article we have present the design and implementation of two chatbots interaction. This consists of KR (Knowledge Reorganization) system, NLP (Natural Language Processing), KB (Knowledge Base) to handle its intelligent capabilities and client server socket system for integration. It has been implemented through Java.

Key Words: Virtual Reality, Agent Interaction, Chatbots, Knowledge Based Systems.

1. INTRODUCTION

During the period of 1956, the field of AI (Artificial Intelligence) took place with a major aim for developing intellectual machines that would be able to think and behave similar to humans. AI is becoming an essential part of the technology industry. AI has paved several scientific ways to modernize, regularize and automatize the manual operation of real world. Growth and advancement of AI has explored dynamic aspects of intelligence and performances by machines, thereby promising scientific significance of agents like chatbots. His article exhibited that how the machine intelligence can be evaluated through what is known Turing Test. In the mid of 1950s; people started struggling for developing an intelligent machine that could be able to pass the Turing test. In such endeavors, special program is called Chatbot which has demonstrated sensible ability to pass the Turing Test with a high level of precision.

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A chatbot is an agent that can be able to communicate with a user or we can say that it is one the type of a conversational agent that will start conversation with a user when you give it inputs in NL and it must be able to respond with something significant in that same language which implies that the quality of a chatbot could be specifically determined by significance of the output choose by the bot in response. Basically chatbots are intentionally designed to replicate an intelligent chat with a single or multiple human users by using auditory or text based techniques [1-2]. NLP and ML (Machine Learning) were observed as the key intelligent feature of a Chatbot. NLP here is referring the usage and ability of systems for processing sentences in a NL such as English. Whereas ML is an area of AI that has focused on the developing of computer programs that may train themselves to grow and change when exposition to new data.

Due to an inevitable urge of secure, systematic and agile perspectives for developing the communications systems, chatbots have acquired a considerable research focus. Recent advances in AI chatbots became accurate and much focused. Chatbots possibly be used in different areas such as for knowledge workers, to use machine intelligence. Smart Chatbot that we can use in live customer support chat channels to answer questions. Chatbot FAQ's (Frequently Asked Questions) is used effectively that can be help full for answering up to 60% of customer calls without any manual interface. Chatbot is used for increasing customer engagement or automatic customer service or in-message payment processing. Chatbot is also help full to streamline security operations and incident management processes [3]. However, there aresome other chatbots that have been specifically designed to be harmful. For example, networks of fake users called "Sybil" on Twitter have been implemented to artificially inflate "follower" counts to increase social status for users who purchase them, to spread fake news or rumors, and even to intimidate users who express certain political beliefs [4].

The aim of this study is to formulate the conversation among multiple chat agents so that in future these agents can be used in many situations such as in collaborative learning, online communication, collaborative work, online shopping and Multi-Player games etc. in order to solve complex problems that are complicated for a single agent to solve [5].

In this paper our focus is in (a) developing two chat agents and (b) their integration that shows how these chat-agents are integrated in order to make them able to communicate with each other. While these chat agents can be capable to interact in quiz-style dialogues by sending and receiving queries and their responses with one another.

The knowledge domain of these chat agents at this time are basic dialogues, though in this paper we do not have focus any problem domain to which these agents can communicate but the main focus of this study is using client server Socket technique to integrate chatbots and initiate a conversation between them.

Keeping in context the research focus and application oriented design of communication systems, our study provides an insight for designing the multi-agent chatbots with prime focus of resolving real time anomalies and improve the performance of existing approaches.

This paper is subdivided into seven sections. Section 2 of this paper describes an overview of some existing chatbot systems. Section 3 details the proposed methodology and its implementation that shows how these agents are developed and integrated. Section 4

describes the software engineering perspective of chatbots. Whereas the section 5 demonstrate the results and discussion that analyze how agents simulate communication in quiz-style multi-party dialogues between chatbots. Final section 6, 7 concludes the paper with a note on future work.

2. RELATED WORK

Bayerque [6] we have seen the introduction of the first wave of AI technology in the form of chatbots. Social media platforms like Facebook have allowed developers to establish a Chabot for their brand or service so that consumers can continue some of their daily actions from within their texting platform. This development of AI technology excited everyone as the possibilities for the way we use to communicate with brands have exponentially expanded.

Consequently, various chatbots, with lots of different reasons to exist, some selected chatbots systems discussed below. Chatbot systems originated with programs like Eliza [4]. The program worked very well and has proved popular in its time, but the same pitfalls that plagued the Turing Test plagued Eliza [6].

Besides from Eliza, another classic chatbot that is known as Parry which has been developed in 1972 by the psychiatrist Kenneth Colby and which was curiously simulated the behavior of a paranoid schizophrenic by generating the logic of paranoid human thoughts through an algorithm [7].

In 1990 the Loebner prize a competition that judge's chatbots based on their human likeness was launched.

Another chatbot ALICE (Artificial Linguistic Internet Computer Entity) was inspired by the Eliza ALICE was a popular award winning Open source and free AI chat robot that has been originally composed by Richard Wallace in 1995. Alice used AIML (Artificial Intelligence Markup Language) for specifying the heuristic conversation rules. It was one of the strongest programs of its type and won the Loebner Prize however the program was unable to pass the Turing test. The ALICE system consists of two modules namely Alicebot engine and AIML KB [2,8].

Kumar and Rose [5] presented a novel software architecture called Basilica for building conversational agents that can support collaborative learning in a powerful way. This involves two or more learners that can interact with one or more conversational agents which are part of a collaborative team working through a learning task.

Mitsuku chatbot won the Loebner prize in 2013. It was one the most human like chatbot that is publically available.

Hettige and Karunananda [2] presented design and implementation of the improved Sinhala chatbot name Octopus. The Octopus has been designed as a multi agent system and implemented through the multi agent system development framework MaSMT. The octopus chatbot supports chat facility through text, action facility that handles limited tasks including execute some command, open or close some application search some result etc. and searching facility to search some files or data inside the PC or throughout the local network. The Octopus consists of 8 sub-systems namely core system, GUI (Graphical User Interface) system, NLP system, communication system, learning system, action system, searching system and data access system and implemented through java.

Setiaji and Wibowo [9] introduced the chatbot application that uses knowledge in database in order to response user inputs. The paper addresses the problem of sentence similarity calculation by using bigram method which divides input sentence as two letters of input sentence. The knowledge of chatbot was stored in the database. The chatbot consists of core and interface that is accessing that core RDBMS (Relational Database Management Systems). The database has been employed as knowledge storage and interpreter has been employed as stored programs of function and procedure sets for pattern-matching requirement. The interface has been built using programming language of Pascal and Java.

Lee et. al. [10] introduced psychiatric chatbot application for better mental health care counseling service. As the chatbot was able to recognize and monitors the human emotion through the continuous observation of conversation and generates an appropriate response based on conversational context, user emotion, and expected reaction by using NLP and emotion recognition techniques.

D'silva et. al. [11] proposed system architecture for customer care where the customer can communicate with the customer care representatives at point of time from anywhere. The system addressed the problem of handling huge volume of users and analyzing each and every customer message which will take lots of time and leads too many unsatisfied customers. As the proposed system analyze social chat by identifying whether the messages from customers are actionable or not Then all the actionable messages are sent to the chatbot which tries to resolve the problems faced by customers by initiating conversation with them as this will facilitates company to save their resources for customer service and also increases customer satisfaction. The architecture consists of ejabberd server that handles the chatting part, AWS (Amazon Web Services) that analyze customer messages and a chatbot that will provide responses to customer messages in order to resolve their problems.

Since the development of the chatbots grow up over time. In an era of tech mobility and functionality that has unfathomable even in the 90^s. Hence it may not a surprise that in 2016 finally we have begun for attaining what we have wanted from computers all along. We begin conversation with them [6].

Chatbots have revolutionized the next generation of human to machine and machine to machine interaction. Nowadays not only we humans communicate but also chatbots that have been created by brilliant minds are also able to communicate with each other [2].

While all previous work has been done on initiating conversation between user and a chatbot. The main aim of this research is to develop multi agent communication system where these chat agents can communicate not only with the user but also be able to communicate with each other as well that can help to solve complex situations that are difficult for a single chatbot to solve, while no such kind of system have been developed using the following methodology yet.

The advantages of these types of systems are to help us in different areas such as education, health, security, business etc.

In addition, Chatbots and conversational agents were anticipated to be important interfaces in VR (Virtual Reality) environments [6].

3. METHODOLOGY

The proposed research is based on making interaction between two chatbots these chatbots have been implemented through the following methodology as shown in Fig. 1. The methodology basically illustrates design aspects of developing multi-agents systems using several parameters of input, processing and output.

Since the application is fully coded in Java language. The techniques that have been used to achieve the results are (a) NLP (b) KR from KB (c) Rules matching (d) Fuzzy String Search technique in order to solve the problem of exact sentence matching to select a reply to the user's input [1] and client server integration.

Input: In this phase the user will give input questions in NL such as in English by typing it into their Chabot interface and send to other chatbot. Once the input is received it needs to be preprocessed before it is to be searched in its KB. Input preprocessing involves (1) convert input text into uppercase, (2) remove extra spaces (3) punctuations that could be found in the input.

Client Server Socket System: Sockets have played a fundamental role in client server applications. Socket programming is one of the technique that can provide the communication mechanism by writing to or reading data from these sockets. A socket can perform four primary operations: (1) it enables to connect to a remote device (2) Send data (3) Receive data and (4) and finally terminate the connection.

Java provided us the facility to create sockets for IPC (Inter Process Communication). We must have to import java.net package while programming for sockets in java [12].

With the help of java client server socket technique, the chatbots can be able to interact such as sends and receive questions and responses. Fig. 2 shows how client server socket system can work.

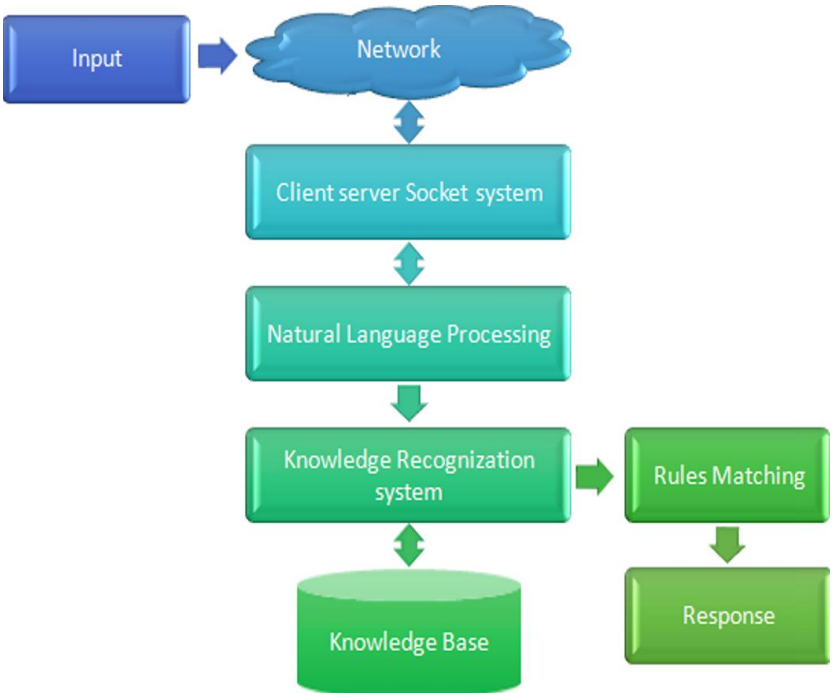

FIG. 1. SHOWS THE PROPOSED METHODOLOGY OF CHATBOTS

Fig. 3 shows how the transfer of data between these agents may occur. By looking at Fig. 3 the dialogue session between the chat agents can takes place when user 1 ask a query from chatbot1, the chatbot1 communicates with other chat agent called chatbot2 that generate an appropriate response and send back to chatbot1 in such a way the interaction between chatbots occurs.

Natural Language Processing: NLP refers to the use and ability of systems to process sentences in a NL such as English. The input for a chatbot is to be processed using NLP techniques in order to generate the response by the chatbot. The input received by the chatbot is to be tokenized first to break the inputs and the current keyword in separate words the output of the tokenization can be used for KR. However, a variety of tokenizers and tokenization techniques are available in java. Fig. 4 show a strongly typed NLP engine.

Knowledge Recognition: KR is a branch of machine learning that focuses on the recognition of patterns and regularities in data. KR algorithms generally aim to provide a reasonable answer for all possible inputs and to perform "most likely" matching of the inputs, taking into account their statistical variation [15].

The program use's the concept of **Fuzzy String Search**. To apply this method, it could be useful at first to break the inputs and the current keyword in separate words, after that we could create two different vectors, the first one could be used to store the words for the input and

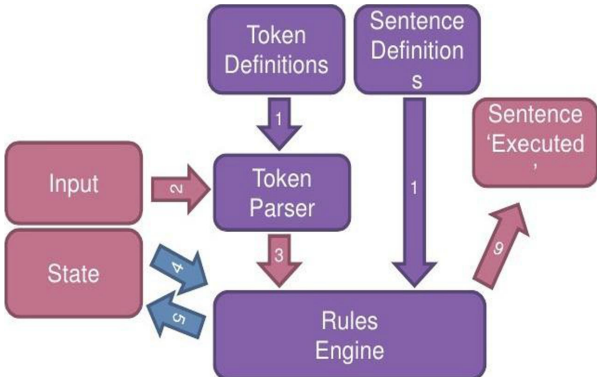

FIG. 4. A STRONGLY TYPED NLP ENGINE [14]

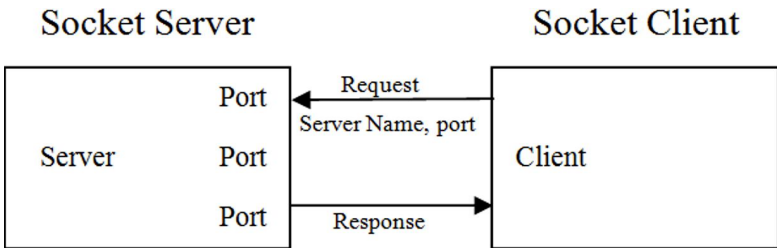

FIG. 2. THE SERVER INSTANTIATES A SERVERSOCKET OBJECT, THAT DENOTES ON WHICH PORT NUMBER COMMUNICATION CAN OCCUR ON. THE SERVER CALLS THE ACCEPT() METHOD OF THE SERVERSOCKET CLASS. THE METHOD WAITS UNTIL A CLIENT CONNECTS TO THE SERVER ON THE GIVEN PORT [13]

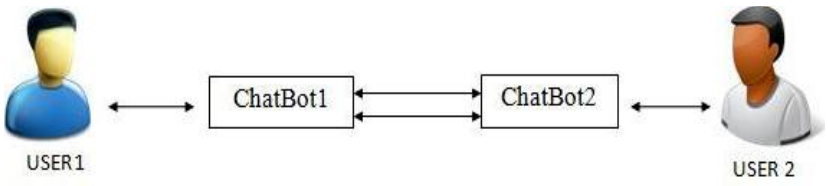

FIG. 3. SHOWS HOW THE TRANSFER OF THE DATA BETWEEN THESE AGENTS CAN OCCUR

the other one would store the words for the current keyword. Once we have done this we could use the **Levenshtein distance** for measuring the distance between the two words vectors [1].

Knowledge Base: A KB is a set of representations of facts of the world. The chatbot are able to interpret the inputs by matching against its KB.

Rules Matching: In this phase the Chatbot manipulate the KB and match the given inputs with list of rules as to find the best match and to produce the responses.

Generate Responses: In this phase the chatbot selects an appropriate response among multiple responses chatbot show response and send/receive the response between each other.

4. SOFTWARE ENGINEERING PERSPECTIVE

In order to acquire efficacy of virtual agents, their adoption in technical environment is an important aspect of their development. However, there are no as such approaches available, like application frameworks and

TABLE 1. THE CONVERSATIONAL DIALOGUES BETWEEN TWO CHATBOTS

Chat Agents	Dialogues
Chatbot1	Hello
Chatbot2	Hi There
Chatbot2	How are you?
Chatbot1	I'm Doing Well
Chatbot1	Are you intelligent?
Chatbot2	Yes, Of Corse
Chatbot2	Tell me more about yourself?
Chatbot1	Chabots are an Intelligent AI Programs
Chatbot1	What kind of techniques you have used to generate response?
Chatbot2	I Think so this is Necessary for your to Know about that
Chatbot2	Tell me more about yourself?
Chatbot1	You are repeating youself
Chatbot1	Do you know about humans?
Chatbot2	I'm not sure if I understand what you are talking about
Chatbot2	What is a Chatbot
Chatbot1	A computer program designed to simulate conversation with Humans Users
Chatbot1	bye
Chatbot2	It was nice talking to you chatbot2, see you next time!

component wares. In such situation, application of software engineering based frameworks can help virtual agents to achieve qualitative justification. In particular architecture of virtual agents systems can well be improved through integrating unified parser. From a software engineering point of view, such assistants should be easily defined for existing or new graphical applications. The design of full-fledge dialog systems requires huge efforts in terms of NLP expertise and implementation time.

5. RESULTS AND DISCUSSION

This paper presents an experimental study that analyzes how agents stimulate human communication in quiz-style multi-party dialogues between chatbots as shown in Table 1. These results are based on an initial experimentation carried out to determine communication performance and proficiency of multiple chatbots. Although, experimentation is subject to certain improvement, however, the results derived indicate robust architectural views of chatbots.

Table 1 shows how these two chatbots generate responses, control the repetition if the current input and previous input is same and handles the situation when the program is unable to find a matching keyword in its KB for the current input, it simply answers by saying that it doesn't understand which is quiet like human. The session of the conversation between chatbots is terminated when any of the chatbot receives the input **BYE.**

Figs. 5-6 shows the results of client and server chatbots conversation

However, the response time is acceptable at this stage because we have limited questions in the KB however, KB may be extended in the future and different metrics can be analyzed deeply to check the accuracy of the system.

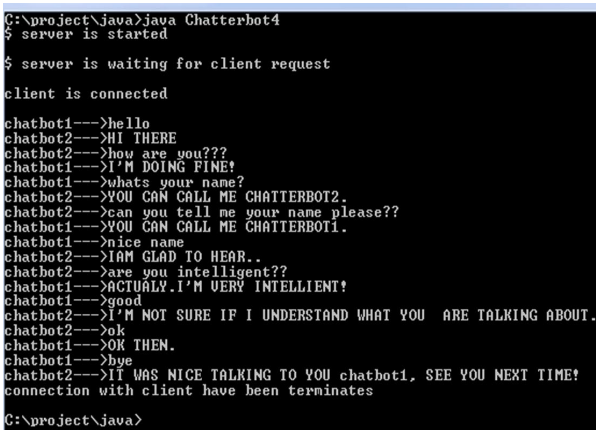

FIG. 5. AN INTERFACE OF SERVER CHATBOT

FIG. 6. AN INTERFACE OF CLIENT CHATBOT

5. CONCLUSION

This paper focused on development multi agent communication system which consist design and implementation of two chatbot communication named chatbot1 and chatbot2.This paper mainly adopts an integrated approach to enhance the performance of multi-agent based communication system. Firstly, the communication model was framed which mainly depicts the application based scenario allowing interaction of two chatbots using natural language processing guidelines. These two chatbots intelligently communicate with each other by using rule based

techniques and finds best match form its KB based on the given inputs in order to generate responses. It consists of the client server socket system, NLP, KR system, KB and rules matching. It has been implemented as a java application and successfully tested. On the basis of results obtained through their communication, it was quite evident that performance, interaction capability, processing mechanism gained significant improvement.

6. FUTUER WORK

In this version of multi agent communication system chatbot application has limited capabilities. Therefore, in future the application can be extended by adding new features such as we can make this application more interactive with the support of graphical user interface GUI.

The chatbots not only interprets the text based questions or responses but also can be enable to understand the recognition and translation of spoken language into text.

We can also develop the system in which multiple chatbots will be able to communicate with each other, with the support of emoji's and animations etc. the communication among multiple chatbots will help us to develop distributed/centralized multi agent systems in which these virtual agents each one with different domain expertise helps the human being in different areas to solve the complex situations.

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