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Design of an Emotional Conversational Cognitive Agent Architecture (ECCAA)

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ABSTRACT

This research is an attempt to substitute an agent in place of a customer care executive in a helpdesk kind of scenario by building an emotional cognitive conversational agent. Some of the cognition that may be required to achieve human like dialog system are goal, desire, belief, intention, decision making, emotions, compassion, emotional pragmatics etc. The research exists as a preliminary approach in building a cognitive conversational agent architecture. The functionality of this Cognitive Architectures is Decision making, Prediction, Problem solving, Reasoning and Belief, action, communication between agents, Learning and reflection.

Keywords: Cognition, Machine Learning, Conversational agent, Belief Desire and Intention, emotional chatbot, social robots.

I. INTRODUCTION

This research paper is an attempt to design the architecture of a conversational agent. Conversational agent usually referred to as 'Chatbots' and are designed using with some limitations. If Turing test is conducted where a chatbot interacts with a human, the questionnaire is very limited. It could a yes/no answers with a narrow knowledge base in a specific domain. Human beings posses a completely different type of conversational talent acquired through learning by observation. After through literature review and study of the way kids develops language skills starting from early ages [7], conversational cognitive agent architecture with emotional quotient is suggested in this paper.

II. RECENT RESEARCH IN GOOGLE

The research team says that the art of conversation is not something that all humans have mastered. But their creation 'ParseyMcParseface' had fetched them a lot of appreciation from all round the world. Google engineer Andrew Dai has trained the robot from 2,685 romance novels. While testing they gave the beginning and end lines and expected it to generate a maximum of 13 additional line which resulted in a contemporary poem. But initially it was only trained in perfect grammar, but they figured out it needed some literary tricks to be feed so that the conversations generated will sound natural.[4]

III. DESIGNING A COGNITIVE ARCHITECTURE

3.1 Computational model of cognitive approach

Computational models of cognitive approach can be based on theory of psychology, philosophy, neuroscience, neural networks etc. One of the approaches in neurology is the Vehicular approach which based on how information is stored or represented in human brain when in conscious state. When some areas in the brain are active in conscious state, we manipulate the information and compare with similar brain patterns [1]. A study also suggests that when a story is being narrated to the audience, the pattern of the narrator is found to be similar to

all the listeners [2]. Another approach in neurology is to control the process running in the brain and understand how cognitive task is executed in the brain to produce cognition. Here a computational model is designed with set of disciplines for the cognitive process to exhibit appropriate behavior [3].

IV. FUNCTIONALITY OF COGNITIVE ARCHITECTURE:

Dr. Langeley [1] says agents acquires knowledge about the environment through perception, implication of situations through reasoning and perception, knowledge is gained through learning, knowledge is also gained from other agent's experience/learning through communication.
[1] Cognitive architecture research issues and challenges, Langley.

Cognitive architectures can be designed by clearly defining the functionality, provide a mechanism based on the functionality and implement the model in real time scenario. The common functionality of Cognitive Architectures are Perception/Understanding, Decision making, Prediction, Problem solving, Reasoning and Belief, action, communication between agents, Learning and reflection. Google's artificial intelligence system, dubbed "ParseyMcParseface," came across as stilted and unnatural, despite (or possibly due in part to) its perfect grammar, engineers decided to teach the bot a few literary tricks. Lessons came in the form of 2,685 romance novels, fed into the neural network over several months. [4]

V. FUNCTIONALITY OF ECCA:

5.1 Design of an Emotional Conversational Agent Architecture (ECAA):

Emotional Conversational Agent Architecture (ECAA) is a 7 Layer architecture where each layer is connected to a specific database which stores successful conversations. Basically the conversations are categorized into 5 different levels such as Reflexive layer, Reactive layer, Deliberative layer, Learning layer and Cognition layer based on SMCA.[5] But in the case of conversational agent architecture we need to further classify the Cognition layer. Thus in ECAA, the Cognitive layer is further classified into Cognition, Meta Cognition and Epistemic Cognition. Apart from the horizontal layers; there are vertical layers such as perception, action and emotion. Thus ECAA is language independent, flexible to all socio-cultural environments. The language and knowledge engine is used to store the syntax, semantics of the language and environmental, social facts respectively. Though the implementation is based on the English language, the model will be universal and will be robust irrespective of the language [5].

5.1.1 REFLEXIVE LAYER:

This is the first layer and it has very limited intelligence. It is based on the biological reflex mechanism which acts instantly before thinking. This layer is completely dependent on the knowledge engine. In conversational agents just one word answers such as yes/no/ok are generated from this layer. The intelligence is only limited to knowing its environment and acting spontaneously. As the intelligence capabilities of the agent increases by experience more answers will fall under this layer. [9]

5.1.2 REACTIVE LAYER:

The next layer is the reactive layer whose intelligence is completely based on facts and general knowledge. Reasoning or decision making is not required for such type of answers. Learned and successful conversations are stored in the knowledge engine and the language protocols such as the syntax and semantics of the language are stored in the language engine. It uses the knowledge engine for the acquiring data and the language engine for communicating.

5.1.3 DELIBERATIVE LAYER:

This layer does the goal based reasoning using heuristic search techniques to choose the most optimum answer for the current situation. Understanding of the environment, the role played by the agent, the purpose of the conversation etc will be the deciding factors. [10]

5.1.4 LEARNING LAYER:

The only task of the learning layer is to store the successful conversations in the knowledge base which will be used by the deliberative layer for future choices. When the agents are allowed to communicate with each other this knowledge is multiply.

5.1.5 COGNITIVE LAYER:

This layer is considered to be one of the layers with the highest levels of intelligence. If this level of intelligence is achieved in our conversational agent then we can consider all the conversations to be successful. This level is achieved when there a proper understanding of the environment, perseverance and problem solving capabilities. This level when achieved could be the closet level to any human to human conversation. [8]

5.1.6 META COGNITION LAYER:

This layer is also considered to be one of the layers with the highest levels of intelligence which is self reflective with consciousness. The agent will reflect on how successful and be able to act wisely and come up with strategies to eliminate failure without any human intervention. So as the agent lives more on certain circumstances will tend to become more experienced and wise like humans do.

5.1.7 EPISTEMIC COGNITION LAYER:

This layer is considered to be in the highest levels of intelligence which is self reflective too. In this level of intelligence the agent must be able to differentiate the known from the unknown. This intelligence is above the human level of intelligence. Here the agent should know that it needs to have more knowledge/information to participate in certain conversations and be able to say 'I don't know' and also have the urge to know. So the agent will know its limitations, will have certainty of knowledge and also the criteria for knowing [6].

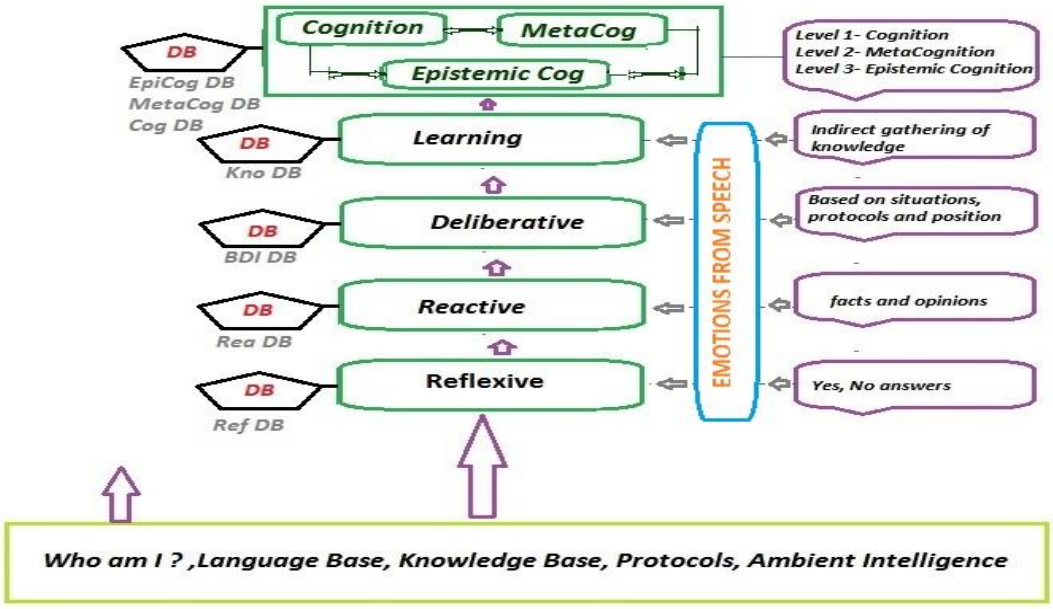

Figure. 1 ECCAA

VI. METHODOLOGY

Data collection is performed form the conversations from old English movies i.e. the 'movie dialogues' (.srt files) are divided into various databases such as Reflexive DB, Reactive DB, Deliberative DB, Learning DB and Cognitive DB (Cog DB, MetaCog DB and EpiCog DB). The stored conversations will be assigned with different weights based on the level of intelligence. An Agent starts with low level conversation and then more on to higher levels based on the experience. Different Agents with various levels of intelligence are incorporated into the test environment. Each conversation of the agent is scored according to the level of intelligence that particular conversation falls into. This information is provided by the databases. The total score is the sum of all the conversations had until now. The more the score is the more intelligent the system is. Number of conversations, level of intelligence is plotted across time to given the result.

Training is done by using Prolog language. The weights are derived using emotions for English dataset (emotion.csv) and trained using Prolog language. Conversations are again trained with the various emotions as weights using deep learning neural network with sequence to sequence model.

Agents will decide on how the conversation will be - based on various factors such as the emotion of the conversing agent, the environment, agent's experience, agent's rationale and other cognitive attributes but this experiment only considers emotions. Like emotion each of the other factors can also be converted into a vector value. So far for limited conversations training was successful. Results will be published when large datasets are used.

VII. CONCLUSION

My research began with designing conversational agent architecture and the layers which I assumed in the beginning were Language (English grammar) knowledge base, the domain knowledge base, the environment knowledge base, the vectors from emotional state of mind etc. But very soon I realized that the way humans learn conversations is completely different. So I started absorbing the way kids learn the language. I was amazed to see them learn and deliver right sentences at the correct scenario. What a design? This is exactly what I am looking in my research. Then the above study was conducted keeping in mind the way humans learn conversing in a language. So now, I conclude that to converse in a language, training set must undergo various stages of learning. The stages are reflexive, reactive, deliberative, learning and cognition. Cognition can further be classified into Cognition, Meta-cognition and Epistemic cognition. Thus the study is complete and provides a platform to implement the architecture practically too.

VIII. REFERENCES

[1]. Rickard,T.C, A Revised Identical Elements Model of Arithmetic Fact Representation. Journal of Experimental Psychology: Learning, Memory, and Cognition, 31(2), 250-257, 2005.

[2]. Eliot R. Smith, Jamie DeCoster, Dual-Process Models in Social and Cognitive Psychology: Conceptual Integration and Links to Underlying Memory Systems, Personality and Social Psychology Review, SAGE Publications Inc, Vol 4, Issue2, pp. 108-131, May 2000.

[3]. Wood, W, Quinn, JM & Kashy, DA, 'Habits in everyday life: Thought, emotion, and action' Journal of Personality and Social Psychology, vol 83, no. 6, pp. 1281-1297, 2002.

[4]. Kantrowitz, Alex, Google Is Feeding Romance Novels To Its Artificial Intelligence Engine To Make Its Products More Conversational, https://www.buzzfeed.com/alexkantrowitz/googles-artificial-intelligence-engine-reads-romance-novels, online 4 May 2016 Accessed 23rd May 2016.

[5]. Venkatamuni, Vijayakumar Maragal. A Society of Mind Approach to Cognition and

Metacognition in a Cognitive Architecture, University of Hull, London, 2008.

[6]. Kitchner, K.S., Karen Strohm Kitchner, Cognition, Metacognition, and Epistemic Cognition, Human Development ISSN-0018716X, December 2009.

[7]. R.Shaffer, David and Kipp, Katherine. Developmental Psychology - Childhood and Adolescence. Chapter 10, Development of Language and Communication Skills, 2010.

[8]. A, Sloman. How To think About Cognitive Systems: Requirements And Design, http://www.cs.bham.ac.uk/research/cogaff/, Online -2002, Accesed 23 May 2015.

[9]. P, Singh. EM-ONE: Architecture for Reflective Commonsense Thinking, http://web.media.mit.edu/~pus, Online-2005, Accessed 12 June 2015.

[10]. N, Davis D., Computational Architectures for Intelligence and Motivation. International Symposium on Intelligent Control, Vancouver, Canada :17th IEEE, 2002.