

# Towards A More Natural and Intelligent Interface with Embodied Conversation Agent

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## ABSTRACT

Conversational agent also known as chatterbots are computer programs which are designed to converse like a human as much as their intelligent allows. In many ways, they are the embodiment of Turing's vision. The ability for computers to converse with human users using natural language would arguably increase their usefulness. Recent advances in Natural Language Processing (NLP) and Artificial Intelligence (AI) in general have advances this field in realizing the vision of a more humanoid interactive system. This paper presents and discusses the use of embodied conversation agent (ECA) for the imitation games. This paper also presents the technical design of our ECA and its performance. In the interactive media industry, it can also be observed that the ECA are getting popular.

## Keywords

Embodied Conversational Agents (ECAs), Natural Artificial Intelligent Neural-network Identity (AINI), imitation games, Turing Test

## 1. THE IMITATION GAMES

Alan Turing was a brilliant British mathematician who played a great role in the development of the computer and posed one of the most famous challenges in Computer Science. One of his most enduring contributions is a simple test he proposed in 1950 that remains one of the most debated issues in the world of artificial intelligence. Turing came up with an interesting philosophy at that time. He constructed the simple proposition that if human beings are intelligent, and if a machine can imitate a human, then the machine would have been considered intelligent. This is also known as imitation game (IG). The IG is now known as the Turing test (TT)[1], was introduced by Turing to decide whether a computer program is consider as intelligent. Turing's aim is to provide a methodology to assess whether a machine can think like a human. He attempts to transform this into a more concrete form by proposing what was known as the IG. The game is played with three persons, a man (A), a woman (B) and an interrogator (C) who may be of either sex. The interrogator stays in a room apart from A and B. The objective of the interrogator is to determine whether person A or B is a woman. At the other end, the objective of persons A and B is to convince the interrogator that he/she is the woman and the other is not. This situation is depicted in Figure 1.



Figure 1. The Imitation Game

Similarly to the IG, to test for the intelligence of a computer system, the Turing test involves a computer, a human interrogator and a human foil. The interrogator attempts to differentiate the computer system by asking questions to the two participants. All communication is performed via keyboard and screen. The interrogator may ask any questions he or she likes, and the computer is permitted to do anything possible to force a wrong identification. At the same time, the human foil must help the interrogator to make a correct identification of the computer system. A number of different people play the roles of interrogator and foil, and if sufficient interrogators are unable to distinguish the computer from the human being then it can then be concluded that the computer has a certain degree of intelligence.

To decide whether the computer is intelligent we replace the question “Can the computer program think?” with the question “On the average, after  $n$  minutes or  $m$  questions, is the interrogator’s probability of correctly identifying the subjects not significantly greater than 50 percent?”[2]

Alan Turing died in 1954, a decade before computer programs such as ELIZA began to proliferate. It is indeed unfortunate that he did not live to see and analyze such programs. Although ELIZA is constructed with the aim to pass the Turing test, but may researchers found that it is

far from it. Over the years, researchers thought it is obvious that no modern machine could yet pass the Turing test. In 1990, Hugh Loebner agreed with The Cambridge Center for Behavioral Studies to underwrite a contest designed to implement the Turing Test[3]. Dr. Loebner pledged a Grand Prize of \$100,000 and a Gold Medal for the first computer whose responses were indistinguishable from a human's. Such a computer can be considered to have the ability "to think". Each year an annual prize of \$2000 and a bronze medal is awarded to the most human-like computer. The winner of the annual contest is the best entry relative to other entries in that year, irrespective of how good it is in an absolute sense [4].

## 2. TRICKS VS AI

Some people interpret the TT as a setting in which you can "cheat". The game has no rules constraining the design of the machines. Turing describes how machines could be "rigged" to overcome certain obstacles proposed by opponents of the idea that machines can think. An obvious example is about machines making mistakes. When the machine is faced with an arithmetical challenge, in order not to give away its identity of being fast and accurate, it can pause for about 30 seconds before responding and occasionally give a wrong answer. Being able to carry out arithmetical calculations fast and accurately is generally considered intelligent behavior. However, Turing wishes to sacrifice this at the expense of human-ness. Some commentators think this is "cheating". The machine is resorting to certain "tricks" in its operations rather than imitating the human ways. However, arithmetic is a highly specific domain. Modifying the programs in this manner cannot hurt: If a machine can pass the test, it can then be re-programmed not to cheat at arithmetic. If it does not resort to this, the interrogator can ask a difficult arithmetical problem as his/her first question and decide that he/she is dealing with a machine right then and there. We believe the best way to handle this issue is considering this as "deception" rather than as "cheating". After all, in a way, the game is all about deception. It can be seen that Turing considers it possible that a sufficiently human-like machine (i.e., a machine that is sufficiently good at playing the IG is bound to make such mistakes as we attribute to humans.

The Turing test in general and the Loebner prize in particular reward tricks, and the winning programs for the last fifteen years have clearly had some tricks. Shieber has criticized the Loebner competition as rewarding tricks [5]. This sort of qualitative assessment to program knowledge is exactly what the Turing test trying to avoid, replacing the question "Can machines think?" with a performance test. Turing's imitation game is generally inadequate as a test of intelligence, as it relies solely on the ability to fool people. This can be achieved easily, as Weizenbaum has found [2]. Here we describe some of the better tricks, confident in the belief that when someday a computer program does pass the Turing test, it will use many of them. There is also a simple reason for this as people are already using them in everyday life. The Loebner contest may just stimulate a few advances in the field of natural language interfaces to database engines.

After all, the chatterbots has already fools "average" questioners. If a larger collection of "tricks" sufficed, would you redefine "artificial intelligence," "average questioner," or "trick?" Perhaps the biggest obstacle to the advancing in this area is there are not many uses for fooling people besides the Turing test [6]

Fifteen years after Turing proposed the imitation game, Weizenbaum's ELIZA program demonstrated that "a simple computer program" could successfully play the imitation game by resorting to a few "tricks," the most obvious being to answer questions with questions[7]. The

**Table 1. Chatterbot Tricks**

Chatterbots	Tricks
<b>ELIZA</b>	<ul style="list-style-type: none"> <li>- Fostered by including substrings of the user's input in the program's output.</li> <li>- Use of the Rogerian mode, which provides unimpeachable cover for the computer.</li> </ul>
<b>PARRY</b>	<ul style="list-style-type: none"> <li>- Admitting ignorance.</li> <li>- Changing the level of the conversation.</li> </ul>
<b>TINYMUD</b>	<ul style="list-style-type: none"> <li>- Introducing new topic, launching into a new story also called as simulates paranoid behavior.</li> <li>- Used ELIZA and PARRY's tricks</li> <li>- Having many fragments of directed conversation stored in activation network.</li> <li>- Changing the level of the conversation</li> <li>- Reply changing the level of the conversation.</li> <li>- Humorous statements to make the program seem more human.</li> <li>- Agreeing with the user, in certain cases, the program can safely agree with the user rather than being non-committal.</li> <li>- Excerpting USENET News</li> <li>- Simulated typing, by including realistic delays between characters and imitate the rhythm of a person typing.</li> </ul>
<b>Hex</b>	<ul style="list-style-type: none"> <li>- Make longer replies and its seemed more human-like that cur reply.</li> <li>- Introduce a new subject with a certain probability.</li> <li>- Give a humorous response if users silence.</li> </ul>

others chatterbots such as PARRY, TINYMUD and Hex also have their own tricks as depicted in the Table 1

## 4. ECA A NEW CHALLENGE

During the past decade, one can observed that there are rapid advances in embodied conversational agent (ECA),

spoken language technology, natural language processing and multimodal interfaces to replace chatterbots which based on pattern matching and typed-text-based. All these have stimulated interest in a new class of *conversational interfaces* [8], [9], [10], [11] and [12]. Many researchers have also been observed in AI researches into natural language conversation [7], [13], [14], [15]. They have proposed different techniques and produced several natural language conversation systems. Every year they present their work by competing for the Turing Test [16].

There are hundreds of different ECAs developed for a variety of reasons. They range from hardwired programs with simply coded patterns to systems built upon embedded learning algorithms which continuously expand their language knowledge base. ECAs are created purely for fun or as part of interactive games, Internet information services, web site guides, e-commerce agents and more. Many ECAs are designed to provide specific information and direct the dialogue to specific topics.

Some ECAs recognize key words; some recognize phrases and others can handle whole sentences. Underneath most ECAs is a "state machine," a kind of programming construct designed to follow logical principles of the form: if  $x$  is recognized then do  $y$  ( $y$  could be either a verbal, textual response or an action). The more sophisticated the learning algorithms that an ECA used, the higher the possibility of the ECA able to "remember" information and use it in further responses. These enable ECA to expand its knowledge by learning new sequences of language from its users. The ECA learns whole phrases, words, or smaller units of language, thus enable them to constantly expand its capabilities.

They have no "brain" in the human sense - just the ability to respond to stimulus, in this case typed words and sentences. They do not seek to model human internal cognitive states; they are designed instead to simulate human intelligence through the use of language.

In the search for the next generation user interfaces, there has been a growing interest in the development of interface agents, which 'personify' the system using an animated character. These agents mediate the communication between the user and the application, and potentially improve the system usability. Ideally, the user should even be allowed to communicate with the agent using natural language, delegating low-level interaction with the system to the agent itself.

These kind of personal companions are known as conversational agent: they are animated in real-time and support natural language communication with the user. Such a 'talking head' can act as an intelligent assistant in many different applications. For instance, it can help the user to choose a product from an online catalogue, mimicking human conversation.

On the other hand, conversational characters represent the convergence of animated interface agents and human-computer dialogue systems. As animated agents get more

realistic, the user naturally expects to be able to interact with them in natural language. And as human-computer dialogue systems develop, it appears that users could interact more readily in natural language if the system is personified through an agent.

## 5. TOWARD NATURAL LANGUAGE INTERFACE FOR ECA

In ECA design, first and foremost, a good grammar unit is necessary. It seems to be a good idea to employ more sophisticated natural language processing methods rather than the conventional pronoun transposition. It could be argued that usage of perfect grammar is not crucial since it is quite rare that humans use perfect grammar in informal communication. A good strategy for the TT is indisputably that of trying to maintain human-ness (or at least the neutrality) for as long as possible. It becomes very difficult for the machine to make the interrogator believe that it is human after he/she has his/her mind set on "unmasking" the poor thing. A promising approach is to develop programs that can learn. In fact, work has been done along this line, but not with the intention of producing computer programs to pass the TT.

Another option is using mathematical and statistical techniques to represent word sequences and probabilities of them occurring in proximity. We expect many of the ECAs in the very near future to use some learning methods. Already, those programs that do not keep track of the current conversation (relying solely on text processing tricks) perform poorly compared to those that learn from the interrogators. As the quality of the conversational systems increase, we believe more developers will integrate learning components into their programs and teach them in a way that maximizes their performance.

One may reasonably challenge any claim of technological superiority of proprietary technologies over another's such as search engine, question-answering system or chatterbots. These have revealed its primary reliance on keywords. For example, if we ask the question that uses two or more important words, like: "*What is a Turing Test?*", following answers will be display as in the Table 2 from the several search engine, question-answering system and chatterbots online:

**Table 2: Responses from the proprietary engines**

ENGINES	ANSWERS
<b>Search Engines</b>	
<b>Google</b>	Reply 4.24 million pages. First hit was "A hypothetical test for computer intelligence, proposed by Alan Turing in 1950, involving a computer program generating a conversation which could not be distinguished from

	that of a real human.”
<b>Yahoo</b>	Reply 1.14 million pages. First hit was “Turing test. From Wikipedia, the free encyclopedia. The Turing test is a proposal for a test of a machine's capability to perform human-like conversation.
<b>Altavista</b>	Reply 1.14 million. First hit was “The Turing Test, defined by Alan Turing in 1950 as the foundation of the philosophy of artificial intelligence. ... The Alan Turing Internet Scrapbook. The Turing Test, 1950 ...”
<b>Natural Language Question-answering Systems</b>	
<b>ASK JEEVES</b>	Reply 452,700. First hit was “The Turing test is a proposal for a test of a machine's capability to perform human-like conversation. Described by Alan Turing in the 1950 paper “Computing machinery and intelligence”, it proceeds as follows: a human judge engages in a natural language conversation with two ... “
<b>START</b>	In 1950, Alan Mathison Turing (1912-1954), an English mathematician, proposed a test for determining if machines might be said to “think.” This test, now called the Turing test, is often mentioned in discussions of artificial intelligence.
<b>ANSWERBUS</b>	Reply with 10 possible answers. First answer was “Beyond the Turing Test General Rules described in this document, the Turing Test Committee will be guided to the best of its ability by the original description of the Turing Test by Alan Turing in his 1950 paper.”
<b>Chatterbots/ECAs</b>	
<b>ALICE</b> (2000, 2001 & 2004 Turing Test Winner)	The “Turing Test” is the name given to a variety of experiments designed to test computer thinking. Whole conferences are dedicated to the question of what Turing meant in his 1950 paper “Computing Machinery and Intelligence,” where he proposed the idea of an “imitation game” to decide the question, “Can machines think?”.
<b>Jabberwacky</b> (2005 Turing Test Winner)	Jabberwacky keep given random answered as follows if you keep asking “What is the Turing Test?”: <ul style="list-style-type: none"> <li>• <i>What IS the turing test?</i></li> <li>• <i>Turing test? Whats that?</i></li> </ul>

<b>AINI</b>	The Turing test is a proposal for a test of a machine's capability to perform human-like conversation.
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What you should have noticed from all the responses from the proprietary engines is that they are either:

- **Search Engine** - pick out one key word/phrase and return documents that are relevant to a user query which normally with million of hits.
- **Natural Language Question-answering System** - generate response using NLP and return few possible answer, possibly in the context of the document where it occurs.
- **Chatterbots** - provide a quick response from the stimulus. Simple pattern matching and substitution, according to a surprisingly small number of pre-defined rules.

The only difference in ALICE.'s response is certain that it does not need a grammatical parser as her knowledge base contains the pattern "TURING TEST" and the witty come-back "WHAT IS THE TURING TEST" with following AIML categories as shown in the Figure 2.

```

<category>
  <pattern>TURING TEST</pattern>
  <template>
    <srai>WHAT IS THE TURING
      TEST
    </srai>
  </template>
</category>
<category><pattern>WHAT IS THE TURING
TEST</pattern>

<category>
  <pattern>TURING TEST</pattern>
  <template>The "Turing Test" is the
name given to a variety of experiments
designed to test computer thinking. Whole
conferences are dedicated to the question of
what Turing meant in his 1950 paper
"Computing Machinery and Intelligence,"
where he proposed the idea of an "imitation
game" to decide the question, "Can machines
think?"
  </template>
</category>

```

**Figure 2. AIML Categories**

For the Eliza and ALICE chatterbots, they are no more or less sophisticated in its ability to handle these kinds of tricks than any proprietary technology. It is because by answering "trick questions", depending on who you ask, they are three possible ways to handle them. They are (a) depends on solving deep NLP problems that are still plaguing us, (b) just depends on a good "botmaster" who reviews conversation logs and continually improves the knowledge base so that the bot answers the question better the second time around, or (c) is plain impossible.

## 6. DISCUSSION

In here, we would like to introduce our own ECA, AINI or Artificial Intelligent Neural-network Identity[17]. For the AINI, response is based on the natural language understanding and reasoning. The reasoning mechanism of the AINI couples the novel idea of complexity reduction during answer discovery in a network-oriented knowledge base with two advanced reasoning features, namely relaxation of event constraint and explanation on failure, to provide higher standards of responses. This statement is well-justified because such advanced reasoning cannot be carried out without the use of domain ontology and knowledge base. This is achieved only with the adoption of these high-level reasoning capabilities, so that the ontological information and knowledge base be thoroughly exploited. Understanding natural language is probably not something that can be done merely on the basis of linguistic knowledge (e.g., knowledge of a grammar and lexicon). It probably requires much world knowledge—not only semantic and pragmatic knowledge, but also something like what the AI researcher Douglas B. Lenat [18] calls “commonsense knowledge”, i.e., lots of facts about the world which has been considered in the AINI development.

The commonsense knowledge has been extracted into the AINI’s domain knowledge from TREC 8 and TREC 9 an annual information retrieval conference and competition’s corpus<sup>1</sup>. This corpus knowledge includes the numeric, entity, explanation, purpose, event, action, weather, state, abstraction, psychological feature, language, phenomenon and process.

Another difference between AINI and other chatterbots is AINI used existing award winning Turing Test knowledge base served as her open-domain knowledge. This trained Knowledge Base is also called Annotated ALICE Artificial Intelligence Markup Language (AAA) [19]. For the domain-specific knowledge, AINI used existing online document extracted using Automated Knowledge Extracted Agent (AKEA)[20]. These web-enabled knowledge databases are accessible via the SQL query standard using single database connectivity in the MySQL database implemented in the three tier architecture.

Our system also differs from other approach because we implemented our chatterbots using Top-down approach for their natural language query [21]. In this multilayer natural language query, plug-in module has been proposed. Our plug-in module consists of spell-checker, Natural Language Understanding and Reasoning, FAQ Metadata and AIML engine module. This plug-in module can be integrated easily and offer a much more scalable approach for the web context than previous work as

<sup>1</sup> <http://trec.nist.gov/>

shown in the Figure 3. In general our approach includes the following stages:

- AINI would parse the user’s input by reading in

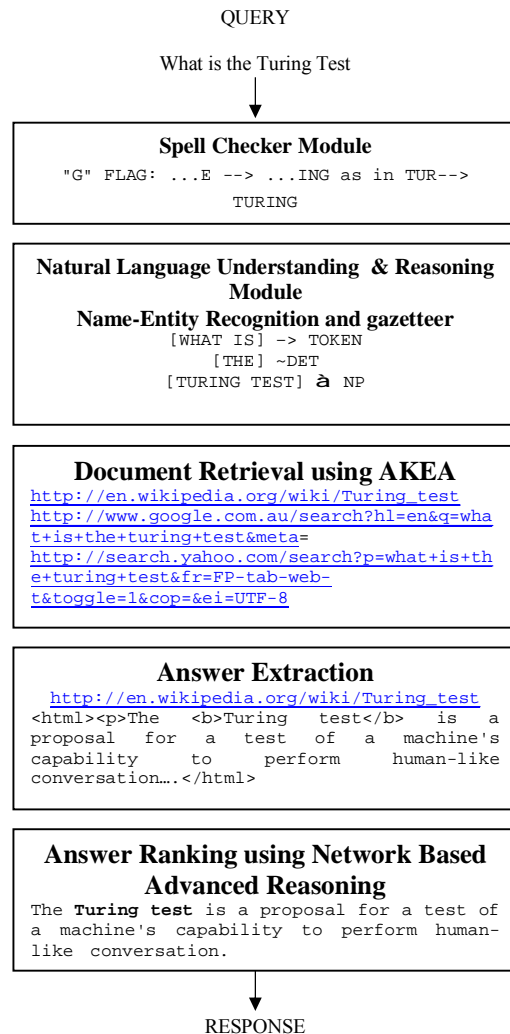


Figure 3. Query and response

sentences one-by-one, and that each sentence would be converted to a list of words to be recognized by spelling checker. Spelling checker will proposed the alternative words from the dictionary if it found any typo(s). If this step is parsed, AINI would attempt to formulate a reply to the sentence by calling next modules;

- The sentence would be send to Natural Language Understanding and Reasoning Module using Minipar [22]. This module will do the sentence parsing to produce grammatical categories and grammatical relationship such as Noun Phrase and Verb Phrase. Name-entity Recognition will then identify each of the keywords to look for a match in gazetteer for

their relation inference and discourse integration. If this step is successfully parsed, the network-to-path reduction will be carried out by Network-based advanced reasoning. From the query network, the set of sequences *question* from the leaf node to the root node is obtained.

- If empty string is returned from the database, AINI would then go to FAQ Module using FAQ question-answering system. In this stage, we are ignoring sophisticated natural language processing or logical inference which has already performed previous module. FAQs are Frequently-Asked Questions documents, designed to capture the logical ontology of a given domain or domain-specific.
- If no database match was found, AINI would then try to go to the next module call Metadata Index Search. Metadata index is information about information: more precisely, it is structured information about resources indexed. It gathers the metadata from pages on the Internet or an Intranet and lets users search the metadata stored in its index. This module relies on the application of a mix of linguistic rules and probabilistic or statistical principles.
- If this too failed, AINI would then try to detect whether the sentence was a trick question. It would look for common ways judges used to trick programs which is commonly found in ELIZA and ALICE. In this case, AIML technology will respond with suitable witty replies.
- If even this module failed to work (which could happen if all of its witticisms had already been used), then AINI routine would be invoked randomly to generate reply. In this stage, the result checking will still be the responsibility of the domain expert, who will be able to correct errors and to pick a proper matching response from a list of possible matches from the conversation log which is unanswered by AINI. This undoubtedly will lead to better performance and accuracy in the future conversation.

In our experiment<sup>2</sup>, we created an amusing and informative example of how chatterbots converse between them in the wild with the simulated "conversation" between Eliza, ALICE and AINI as depicted in the Figure 4. In this conversation, most of the AINI's knowledge are extracted from the AAA knowledge base. This is because,

<sup>2</sup> All the experiments described in this paper were performed by the authors using search engine (Google, Yahoo, Altavista), natural language question-answering system (START, ANSWERBUS, ASK Jeeves) and chatterbots or ECAs (Eliza, ALICE, Jabberwacky and AINI) in the period of January – June 2006.

during the conversation between chatterbots, majority of the questions are based on the open-domain knowledge base, instead of domain-specific.

In addition, from the conversation logs, how well does the chatterbots really remember the thread of your conversation? Many chatterbots will ask your name, and incorporate this into future responses. Some bots also attempt to identify the "topic" of conversation, and a few will be able to tell you what the topic is when you ask about it (although even this is rare). Just remember that asking your name, or any other piece of information, and storing it in a variable for later use doesn't constitute "understanding" what's going on in any sophisticated sense, nor is it the basis for "reasoning" in any sense of the word. Many companies try to pass off tricks like this as a kind of "memory" or "knowledge of context".

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Eliza :Hello. I am ELIZA. How can I help
      you?
AINI  :Hi there! Hi, ELIZA.
ALICE :OK I will call you ELIZA. Just keep
      talking to me as long as you can.
AINI  :My name is Aini. Gosh! Chat amongst
      yourselves.
ALICE :I'm pleased to introduce myself to
      you, Aini. Do you have any conditions
      I should know about?
Eliza :Oh, i have any conditions you should
      know about.
AINI  :Aha. Cool. I have a friend named
      E.L.V.I.S.
ALICE :Next question? That's nice. I have a
      very nice programmer.
AINI  :Do you have any hobbies? You can
      click on the button on the bottom
      right corner to get more news. I have
      a great botmaster.
Eliza : Oh, i can click on the button on the
      bottom right corner to get more news
      you have a great botmaster.
ALICE : And? Oh you can, can you?
Eliza :Oh, i can can i.
AINI  :Oh you can, can you?
ALICE :I see. No I don't think I can do it.
ELIZA : Why do you not think you can do it?

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**Figure 4. Conversation logs between three chatterbots**

In the last conversation, you could see how well does the chatterbots really understand "anaphora"? Anaphora are references to previously-named things. In English, pronouns like "I", "me" "you", "he", "she", "it", and so on usually refer to previously named people or things. Some chatterbots companies will pretend that their software can really identify the target of an anaphoric reference. But such claims can be proven false, and can easily be shown to be keyword-based as well. You need

only pursue a dialog a few turns to show that a chatterbots really has no clue what you're talking about, beyond a rudimentary index of the "current topic".

You can try all the tricks you want; some of them will get you witty answers, a few will even be answered "correctly" (until you twist the trick a bit more), and most will just get you a plain stupid answer.

## 7. CONCLUSION

This paper has given an overview of the imitation game, Turing test and ECA. This paper also provided an analysis into the intelligence of ECA and shows the feasibility of our own ECA, AINI. From the discussion, it can be seen that with the top down design approach, our ECA can converse reasonably well as compare to ELIZA and ALICE. This has indicated that our AINI has potential to be used as a natural interface for most interactive media applications like game.

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