

1 ABSTRACT

DuARTE Digital is a virtual agent with both teaching and entertainment goals.



DuARTE Digital

He answers questions about a famous piece of jewelry from the 16th century: Custódia de Belém. Placed on a public Museum, DuARTE interacts with a heterogeneous audience.

Here, we present a simple and straightforward model of interaction that allows a virtual agent:

- to understand different interlocutors based on their vocabulary; and,
- to adapt to their expertise and information needs.

To assess the adequacy of the model, a twofold evaluation with simulated users and human subjects was conducted.

2 MOTIVATION

DuARTE Digital has a Knowledge Base (KB) of sentences that answer the users' questions.

For a given question, and from a set of correct answers, he randomly picks one and presents it to the user.

However, this can limit the agent's interactive capabilities:

- individuals have different ages, backgrounds, previous knowledge...
- ... and motivations for the interaction.

DuARTE should be able to cope with these differences, by:

- recognizing the user's knowledge on the topic and discovering what s/he intends to know;
- adapting its vocabulary and dialogue strategy to cope with his/her characteristics and expectations.

6 CONCLUSIONS

The evaluation with simulated users suggested the adequacy of the model to different types of users.

Preliminary evaluation with human subjects lacked on users from disperse graph regions. Nevertheless:

- users were usually satisfied with the interaction; and,
- they gave more importance to wrong answers than to answers which they might have not totally understand.

Future Work

Refine the user model, taking into account other language features besides the lexicon.

Extend the work to a broader domain and further explore this methodology.

FUNDING

Work partially supported by a PhD fellowship from Fund. para a Ciência e a Tecnologia (SFRH/BD/43487/2008).

3 UNDERSTANDING

Since DuARTE Digital communicates through spoken Natural Language, he relies on the analysis of the received question to understand the user.

Understanding the User's Expertise: What does the user know?

Users have different knowledge about the words and expressions used in the art domain.

The lexicon is weighted with its difficulty level. The user expertise is:

$$E_m = E_{(m-1)} + D_q,$$

at a moment m and being D_q the difficulty of the user question.

Understanding the User's Needs: What is the user interested about?

Two edge situations were considered as possible:

- the user is interested in a sub-domain of "Custódia de Belém";
- the user just wants to be entertained or does not know the domain.

Sub-domains were defined:

- GENERAL: *What is Custódia de Belém?*
- ORIGIN: *Who created this masterpiece?*
- CHARACTERISTICS: *Why is it golden?*
- HISTORICAL PATH: *Was the piece stolen?*
- INDIRECT: *What is an armillary sphere?*

For every question, its proximity to different sub-domains is measured.

The orientation of the interaction at a moment m to a sub-domain t is based on the history of formulated questions, and defined as $I_{t(m)}$.



Custódia de Belém

4 ADAPTING

The proposed model is described in terms of a 2D graph, where:

- the X axis represents the perceived user's expertise in the domain (unacquainted to expert);
- the Y axis relates with the interaction's orientation towards a sub-domain (stray to directed).

Adapting to the User's Expertise

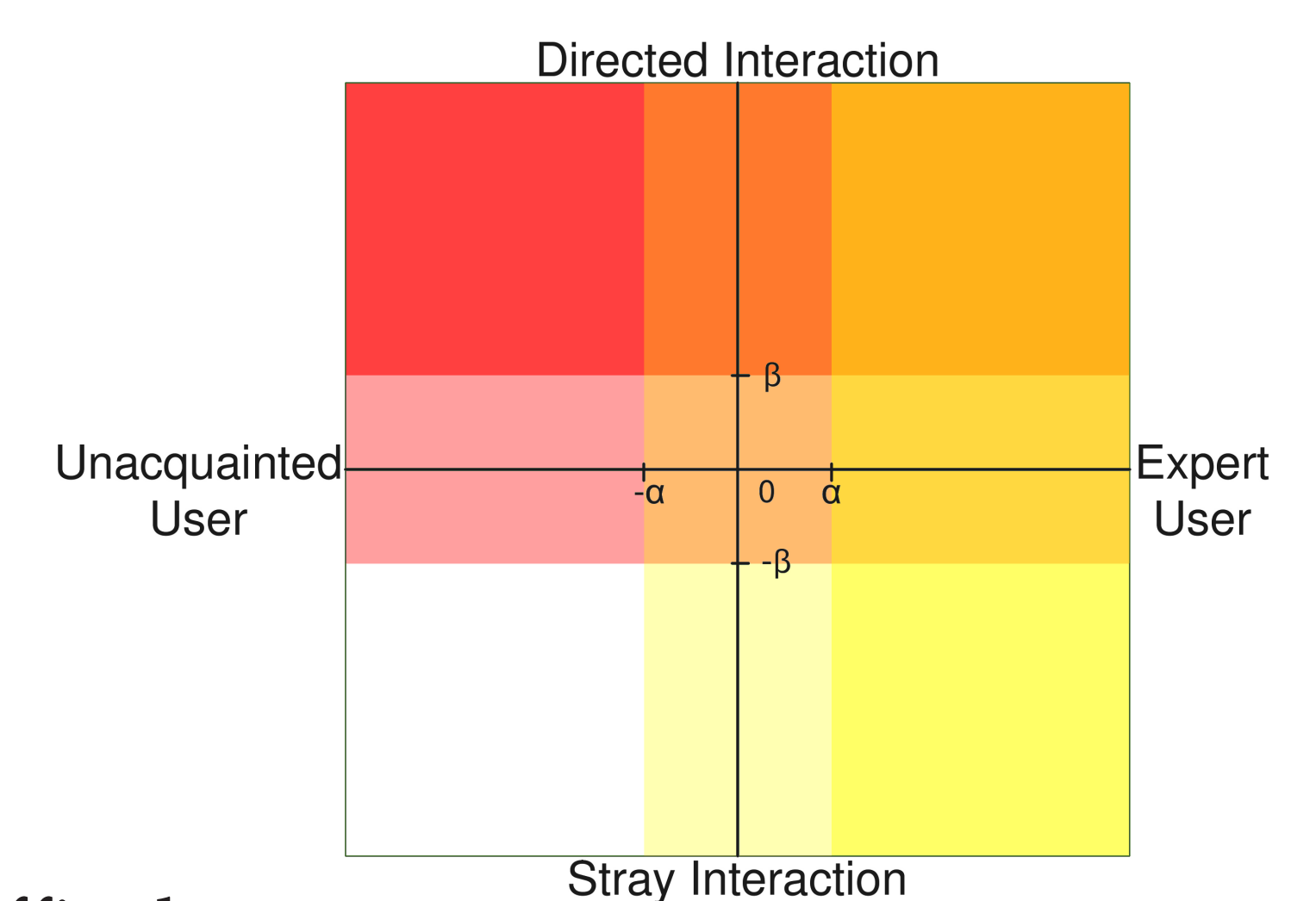
Every answer in DuARTE's KB is tagged based on its difficulty.

- if $E_{(m)} > \alpha$ the user is an *expert*, give a complex answer;
- if $E_{(m)} < -\alpha$ the user is *unacquainted*, give an easy answer;
- otherwise give a neutral answer.

Adapting to the User's Needs

Answers in the KB are classified according to their informative level.

- if $I_{t(m)} > \beta$ the interaction is *directed*, give a detailed answer;
- if $I_{t(m)} < -\beta$ the interaction is *stray*, give a concise answer and guide the dialogue flow;
- otherwise give a neutral answer.



5 EVALUATION

Evaluation with 20 Simulated Users

Each asks 10 questions about Custódia de Belém and the art domain.

DuARTE employs the model with 10 of the users; with the other 10, he picks a correct random answer.

Evaluation with 16 Human Subjects

Previously tagged as *unacquainted*, *neutral* or *expert*. They interact with DuARTE, 12 with the model of interaction.

Question: Did the agent successfully recognize its interlocutors' expertise?

Tagged Expertise	Perceived Expertise		
	<i>unacquainted</i>	<i>neutral</i>	<i>expert</i>
<i>unacquainted</i>	2	5	-
<i>neutral</i>	2	1	-
<i>expert</i>	-	2	-

• With the model, 87 of the 100 answers were adequate to the user expertise (53 without).

• DuARTE gave enough information so that 9 questions could have been obviated, as they had already been answered (6 when the model was not used).

• One user did not totally understand all the answers (an unacquainted misperceived as neutral), suggesting the applicability of a model that differentiates users based on their expertise

• Some users did not ask questions as expected: the experts did not fully explore DuARTE's capabilities by using complex terms.

• Most users did not know what to ask. In these cases (stray interactions) nearly 60% of times the user followed the agent's guidance

• 87,5% of the users were satisfied or very satisfied with the interaction

• Higher correlation between satisfaction and correct answers, than with other variables