Feeding memes: a verbal communication challenge

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Abstract. Feeding memes is a verbal communication challenge for use in collaborative museum visits supported by mobile devices. It is presented in the form of a game, where each player is given the task of feeding bits of culture (memes) to a meme-hungry pet living in his/her portable device. We discuss the design of the game, the background technology, the technical challenges, the expected benefits of developing and experimenting with the game.

Keywords: Game design, mobile games, natural language acquisition and generation, edutainment.

1 Introduction

Mobile communication and computing systems have to cope with issues such as poor network coverage, variable signal strength, inaccurate positioning and limited resources provided by mobile devices. Hiding these technological gaps does not make the problems disappear and it has been reported that users experience frustration with limitations that they are not aware of [1]. The idea to exploit such limitations in the design of a system, i.e. the concept of *seamful* design [2], has recently been applied to create new kinds of location based games, where overcoming the limitations in network communication and positioning technology is made part of the challenge [3**].**

A different kind but serious technological gap is at the man-machine interface. State of the art technology in natural language understanding is simply not good enough and dialogue systems with bots and digital agents are a constant source of frustration. We propose to explore the application of the *seamful* design idea in designing a language communication game, where the challenge is exactly that of verbalizing information in a form that can be effectively reused by the system. The game is meant to encourage collaborative exploration of museums or exhibitions with the support of mobile devices.

The game is called tentatively *feeding memes*, since it has been largely inspired by the theory of memes, units of cultural information that are transmitted by imitation [4]. The task is feeding knowledge acquired during the exploration of the museum to *meme-eager* virtual pets living in a visitor's portable device.

2. Background

The word *seam* is used to designate a failure in communication or in transduction when different tools or media are used together. Weiner suggested that *seamless* design is a misleading goal and argued for systems which are able to live with or even exploit current limitations in technology [2]. *Seamful* design has recently been applied with success in designing location based games: in the game of Feeding Yoshis [3], players have to look for Yoshis to feed and plantations for growing fruits; Yoshis and plantations are wireless access points scattered around the town.

Man-machine communication in natural language is a well known instance of technological seam; despite progresses made in this field, full text understanding is beyond the state of the art. The game uses the metaphor of digital pets eager for cultural food to induce a responsible attitude in the players and create a rewarding experience. In order to succeed in their mission they must be aware of current limitations in text understanding and are challenged to overcome them.

An introduction to the meme theory can be found on Wikipedia.

The term "meme", introduced in 1976 by Richard Dawkins, refers to any unit of cultural information, such as a cultural practice, idea or concept, which one mind transmits (verbally or by demonstration) to another mind..[1]

Memes have, as fundamental property, evolution via natural selection: they replicate, mutate, compete and, if successful, survive. Differently from genes, they are transmitted horizontally by imitation, rather than being inherited from one generation to the next. The meme theory is complex and controversial. Among other things it tries to account for possible winning factors in memes transmission and offers interesting ideas for the design of a useful scoring mechanism for the game [4]. For example *experience* (in the sense of correlation with previous knowledge), *happiness*, *fear*, *pruning*, *censorship*, *economics* and *distinction* have been suggested as plausible influencing factors in meme survival.

Inspired by the explanatory power of this theory, we imagined meme hungry creatures and described the communication challenge as feeding memes to them.

As part of the Mobile Guides project we are implementing a system for natural language generation (NLG), adaptive in several dimensions. A full-fledged typical architecture for NLG is described in [5]. It consists of several tasks: content selection, discourse planning, sentence planning, linguistic generation.

In the domain of cultural tourism or museum guides, where cultural contents are often available in textual form, the dominant approach to NLG is a simplified and practical one, based on predefined text templates that are selected and dynamically adapted. One of the main problems is in fact acquiring knowledge in structured form, so that it can be assembled and combined by the system in flexible ways. Full-fledged NLG systems have instead been successfully developed in domains such as tourist guides for restaurants or hotels, train schedules, technical manuals where information is stored in databases or is the output of an expert system.

Knowledge acquisition represents a serious bottleneck, when developing contents for museum guides. The meme communication game could help in gathering

[1] Definition from Wikipedia (the free encyclopedia) <http://en.wikipedia.org/wiki/Meme>

information in a modular and structured form, thus contributing to the creation of a flexible body of knowledge to be used in experiments of NL generation.

3. The Game

For the purpose of playing the game, players gather in communities or lobbies, while exploring the museum or exhibition. Each player's portable device, i.e. PDA or wireless enabled cellular phone, hosts a virtual creature which must be fed cultural fragments (memes) to evolve; if not fed, it regresses for lack of culture.

Creatures act as virtual pets to their player. When they are fed memes that they are not able to grasp, they look puzzled but behave cooperatively. They give account, on request, of the information they have about a subject, to help acquiring new related memes. If fed new memes that they can digest, they look happy and behave even more cooperatively. The ones that are able to absorb more food, slowly develop a respectable professorial look and candidate as *group experts* or *master*. If left alone or not fed appropriately they look bored, or even depressed; later on they develop "primitive" traits: they grow hair, start using inappropriate language, develop bad behaviors (spitting, insulting) and eventually get expelled from the group.

When close to a hot spot and able to connect to the wireless network, creatures of the same team share their memes. Valuable memes are the ones that contribute to the group knowledge and have a greater possibility of being useful when transmitted to the other creatures. Players are encouraged to actively seek these opportunities for sharing, looking for hot spots. Presence in hot spots is also an occasion for synchronizing scores and electing a group leader (the master). This can be regarded as another instance of seamful design, similar to the one exploited in Feeding Yoshis [3]. Direct communication among players should also be possible on separate channels, i.e. Instant Messaging channels; players could exchange hints on how to effectively communicate knowledge to their meme-eating creatures or setup meetings at a location to discuss the strategy.

The scoring mechanism encourages a notion of focus to prevent talking about random things and disregarding the contents of the exhibition. The words used should "comply" with the lexicon of the exhibition, by making memes referring the items on display receive a better score.

At the end of the game, natural language reports are generated for each team, giving account and presenting in a coherent text the knowledge acquired by the group during the visit.

4. Technical Challenges

The main technical challenge in implementing the game relates to the use of knowledge representation and language technology.

A suitable language for representing fragments of knowledge internally should be formal enough to allow for limited forms of reasoning, such as inheritance and referring expression identification but at the same time not so removed from natural

language and normalized that text generation results in extremely poor text. What we plan to use is a language for expressing semantic relationships among participants in a sentence. For example: *Guernica is a famous painting by Pablo Picasso* would be internally represented by a set of relations:

```
is("Guernica", "famous painting")
author("Pablo Picasso", "Guernica")
```

A dependency parser can be used to produce a syntactic dependency tree from the text:

```
subj("Guernica", "is")          mod("painting", "by")
pred("is", "painting")          prep("by", "Picasso")
mod("painting", "famous")       mod("Picasso", "Pablo")
```

The semantic representation can then be obtained by a *semantic role labeling* process based on the dependency tree. Even if not perfect, the language technology is there to support this task. We have developed our own set of linguistic tools and in particular a language independent statistical parser which is quite efficient and achieves reasonable accuracy on unconstrained text [6]. More important from our perspective, the game encourages verbalization of knowledge in simple form; so we expect that the technology will work well in supporting the game.

What we need, to start with, is a domain lexicon which is easy to obtain from descriptive material about the museum or exhibition. This serves the purpose of encouraging the use of appropriate terms in meme production as well as keeping a focus on the subject. A lexicon of forbidden words could also be used to discourage offensive language. One might consider also using a general thesaurus such as WordNet[2] as background knowledge about language. A basic body of knowledge in meme form could also be used as background knowledge, to make things more interesting in the early stages of the game.

New knowledge is acquired as part of the game while players strive to provide food to their meme-eating pets. Knowledge is provided in the form of short sentences in natural language, as text written in a text box in the PDA interface, or speech, if the technology is available for voice input.

Summary generation is the most challenging part. It requires all the machinery of a full- fledged NLG system. Evaluation of the final reports should be done by humans for assessing the quality of the information produced as well as the quality of the generated text.

The feedback at the user interface and designing a suitable scoring mechanism to support it, are a further technical challenge.

An immediate feedback is given on the intelligibility of the natural language sentences that are provided (related to the outcome of the statistical parser, which assigns probabilities to classification tasks) and their relevance to the subject (based on the lexicon). This feedback is reflected in the expressions of the creatures: puzzled look, happiness to various degrees.

When synchronization occurs, individual player's scores and team scores are computed on the basis of the information provided. The scoring mechanism reflects the value of the knowledge provided. Aspects that are taken into account are: whether

[2] WordNet: a lexical database for the English language <http://wordnet.princeton.edu/>

the memes are redundant or contribute new knowledge, whether the new memes "connect" to other memes already there. If this happens it will be possible to derive new knowledge or discover interesting connections. A meme who is completely isolated is pruned and very likely will not be taken into account in the final report.

What will prove to be effective will be simple and short phrases that can be parsed without ambiguities and have a potential for merging and enriching the body of knowledge gathered collectively by the group.

Finally, as a last challenge, distribution and communication play an important role in the game. Usual problems are: localization, support for distributed computation. As part of a national project on Mobile Guides, we have developed a software framework for location aware mobile games for the .NET platform and using devices running Windows Mobile. Indoor localization is done relying on BlueTooth beacons.

5. Conclusions

We presented the design of a new game for supporting group visits in museums or exhibitions. The game is meant to encourage the *active exploration* of the museum to acquire information and the *verbalization* of the acquired knowledge in a form suitable for man-machine communication; it is our hope that this will also foster more effective communication among humans. The game stimulates *distributed and exhaustive exploration* for the fact that novel knowledge is scored higher, and *team work* since additional value comes from the connections that the system is able to establish among the pieces of knowledge which are gathered by different players. The device of the meme hungry pets is meant to provide enough stimulus and fun to justify the effort of writing down memes.

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