

A Study on Effects of Agent Movement on User's Impression

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Abstract: Non-verbal information plays an important role not only in human-to-human communications but also in human computer interaction. In this paper, we examine effects of human-like agent's primitive movements on user's impression, where the human-like agent's primitive movements include eye, mouth, and head. SD (Semantic Differential) method was used for evaluation, and two factors were extracted as a result of the factor analysis. It is found that the first factor influenced the user's impression particularly.

1. Introduction

Multimedia content search and retrieval is becoming one of interesting research topics and one of important practical areas of multimedia applications [1],[2]. As one multimedia content retrieval system, we are developing a multimedia navigation system (Fig. 1). In this system, a user terminal is connected to plural multimedia content archives via the Internet. In the media retrieval application on the user terminal, there are a media search module and a system QoS (quality of service) measurement module, which is used as a criterion of service quality for accessing the archives. At present, the network throughputs for respective multimedia content archives Th_1, Th_2, \dots, Th_N , are measured and used as the system QoS. The media search

module accepts searching words from the user and carries out key word matching operations to find out the appropriate multimedia contents for the user's request. By considering the network throughput, it was verified that the user's response time, that is a QoS factor, was improved by 9.32% on the average in comparison with that without considering the system QoS in a prototype of multimedia retrieval system [3].

After the multimedia search and retrieval, human-like agents are expected to be useful for User Interface (UI) of the multimedia system to present the retrieved contents for the user. Designing of the agents is important to make them friendly and natural, so that non-verbal information such as eye contacts and gestures should be used efficiently [4],[5]. More generally, the non-verbal information in human-to-human communications includes posture, distance, appearance caused by dressing *et al.*, and physical features, and it is reported that 65% [6] or 93% [7] of message transmission among humans are occupied by the non-verbal information.

In this paper, considering movement of eye, mouth, and head as the non-verbal information, we examine how much they influence the user's impression by subjective tests. SD (Semantic Differential) method is used for evaluation of the tests. As a result of the factor analysis, two factors were

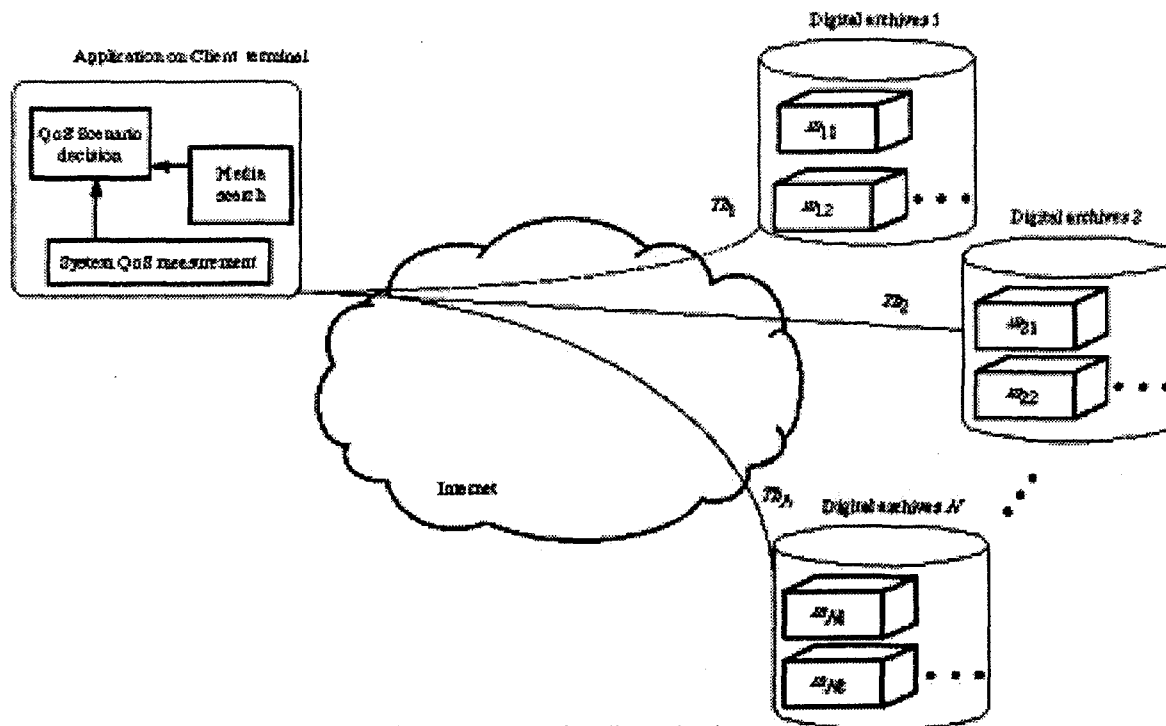


Figure 1. A multimedia navigation system.

extracted, wherein it is found that the first factor influenced the user's impression particularly.

The rest of the paper is organized as follows. Section 2 describes the subjective tests that we carried out to evaluate agent's movements on user's impression. In Section 3, experimental results are presented. Section 4 concludes this paper.

2. Subjective tests for impression of agent's movements

Figure 2 shows the experimental system of the subjective tests. A testee sits in front of the 19.6 inch display in which an agent appears to explain on a scenery image. The explanation is provided to the testee by a headphone. Figure 3 shows a scene of the agent explaining the scenery image. The agent has three primitive movements on mouth, eye, and head (neck). The mouth movement synchronizes with the voice of explanation as if the agent utters the voice, and the eye movement imitates blinking. Lip synchronization is not implemented for the mouth movement. The head movement means tilting the agent's head at a joint of neck, which imitates a habit of the agent.

In the subjective tests, the testee evaluates impression received by the agent's movements under the following various conditions.

- Condition 1: no agent.
 - Condition 2: agent without any movement.
 - Condition 3: agent with mouth movement only.
 - Condition 4: agent with eye movement only.
 - Condition 5: agent with mouth and eyes movements.
 - Condition 6: agent with mouth, eye, and head movements.
- (In the Condition 1, no agent appears in the scene.)

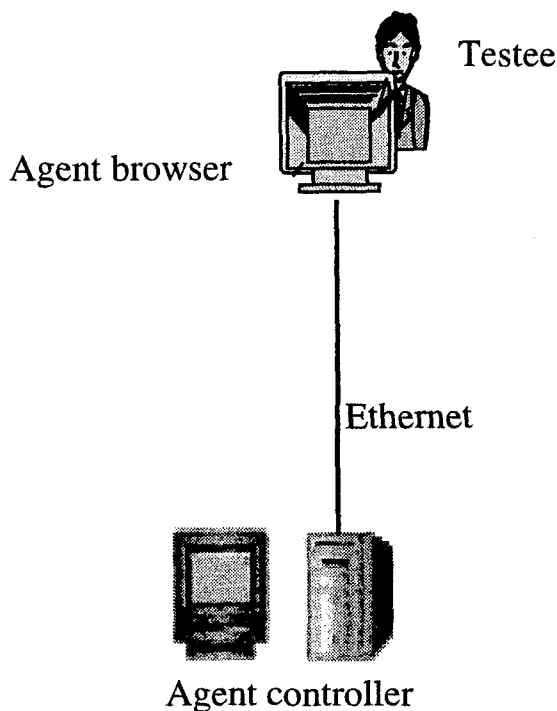


Figure 2. Experimental system.

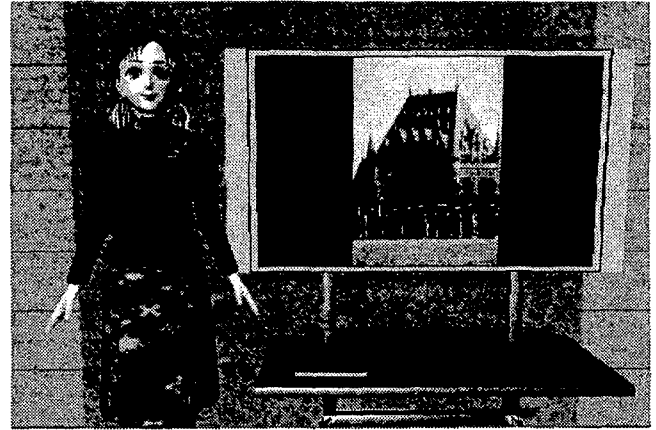


Figure 3. An agent explaining scene.

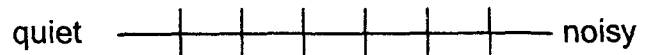


Figure 4. An example of evaluation items.

The testee evaluates the impression of the agent's movement by SD (Semantic Differential) method, where the testee scores by 7 levels between a set of adjectives that have opposite meaning. We prepared 24 sets of adjectives such as quiet-noisy. Fig. 4 shows an example of evaluation items that the testees used. The number of testees whose ages were 20s was 20 (11 women and 9 men).

3. Experimental Results

As a result of the factor analysis of the experimental results, two factors were extracted. Table 1 presents major three adjectives that contribute to respective factors and interpretation of the extracted factors. Especially, Factor 1 influenced the user's impression more explicitly than Factor 2. Figure 5 shows contribution degrees of the extracted factors for each experimental condition from the left-most to the right-most orderly. That is, in Fig. 5, the left-most "No Agent" corresponds to Condition 1, the next "Standing" does to Condition 2, and so on. It is found that clear contribution of Factor 1 has appeared under the conditions of "M.&E." and "M.&E.&H.," although the contribution has not occurred under the rest four conditions. It means that joint effect of mouse and eye movements causes the users impression of activeness and warmness. Moreover, it can be said that the additional head movement to the mouse and eye movements strengthen the impression.

Table 1. Adjective items and interpretation associated with the extracted factors.

	Adjective items	Interpretation
Factor 1	Positive, Bright Soft	Activity, Warm
Factor 2	Intense Noisy Forcible	Power

4. Conclusions

In this paper, the effects of agent's primitive movements on user's impression were studied by subjective tests. The tests were carried out based on the SD methods, and their results were analyzed by the factor analysis. As a result, it is found that the combination of eye and mouth effected on user's impression more than only the eye or mouth movement did. This result will be useful for designing the interface agent that intermediates the user and the system naturally. We are planning to implement these results into the interface agent of our multimedia navigation system.

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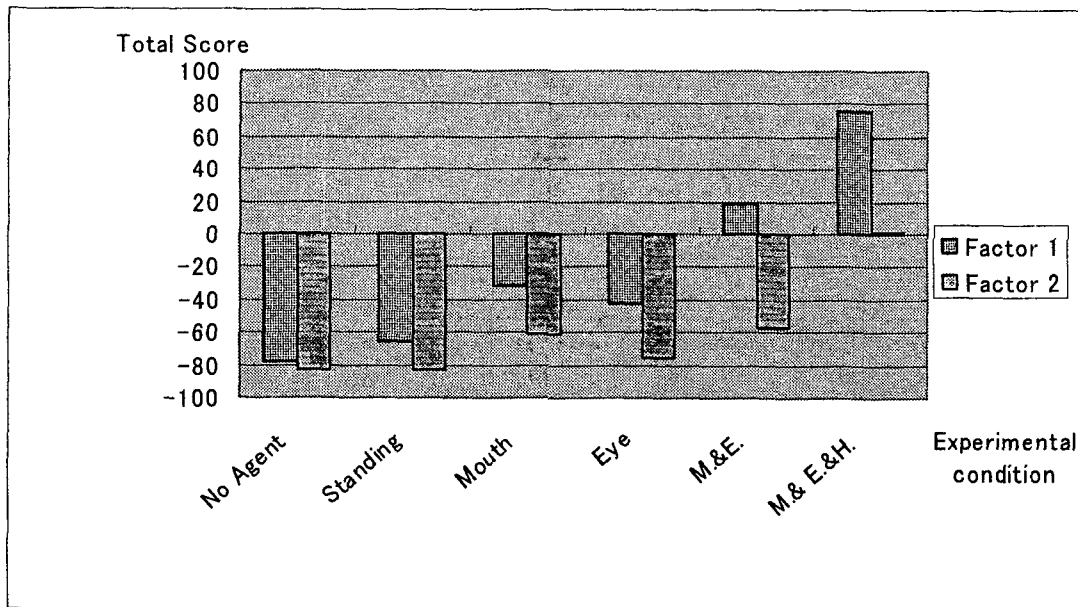


Figure 5. Experimental condition v.s. total score of the most four contributed items for all testees.