

Interactive Story Creation for Knowledge Acquisition

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Abstract—This paper proposes an agent system that semi-automatically creates stories about daily events detected by ubiquitous sensors. These stories are knowledge of inhabitants' daily lives and it may be useful for human-friendly agent. Story flows in daily lives are extracted from interaction between sensor room inhabitants and a symbiotic agent. The agent asks causal relationships among daily events for inhabitants to create the story flow. Experimental results show that created stories let created stories perceive agent's intelligence.

Index Terms—Humanoid Robot, Ubiquitous Environment, Story Creation.

I. INTRODUCTION

Human-friendly agents are now receiving much attention due to the advance of sensing technologies [1]. In a ubiquitous environment environment, they support human activity by using sensors like their sensory equipments [2]. However, sensor data is poor information for human and can not be used easily for communication between human and agent. Therefore, we proposed a method to create stories from sensor data semi-automatically. Stories are plausible media for presenting stocked information to others because people remember daily events as stories through restructuring their stories when a new event occurs and tell these stories to others in their lives [3]. Also, stories are the nature of human intelligence [4]. Thus, the acquisition and manipulation of stories may provide knowledge and intelligence like human to artificial agents.

In the rest of the paper, related works are briefly addressed in section II, followed by the story creation method in section III. Section IV explains the details of the story creation system. An experimental result is presented in section V and the conclusion and future work are given in section VI.

II. RELATED WORKS

Ho et al. [5] focus on intelligence of narrative and propose a framework to model human autobiographic memory for believable virtual characters. They argue that narrative can add some "intelligence" to agents. Thenune et al. [6] propose a story creation system by multi-agents that interact with each other and create plots of events in a virtual environment. At the end, the presenter tells created stories to users. These story creation systems can not create stories in the real world.

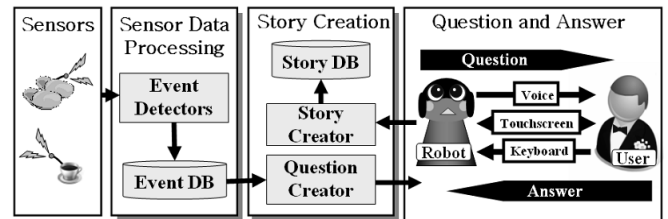


Fig. 1. Story creation system

III. STORY AS CAUSAL RELATIONS BETWEEN EVENTS

Story creation connects events according to some relation. Riessman [7] argues that there exist three kinds of basic relations: chronological order, causal relationship and topic commonality. We used causal relationships of events to create a story because causal relationships include elements of other relations, so causal relationships are useful for the future use. For example, we assume that a person missed a bus and was late for a meeting. A story is created by connecting two events: "missed a bus" and "late for a meeting."

We give an agent work to ask about causes of an event. In that course, people do not find it troublesome to create stories because the agent presents candidate causal relationships. Answers select the most probable causal information from candidates presented by the agent or directly input text that describes the cause. The input is used for story creation and created stories stored in the system for the future use.

IV. INTERACTIVE STORY CREATION SYSTEM

Figure 1 shows an overview of our story creation system. A ubiquitous environment can sense events that occur in the real world. An agent semi-automatically creates a story of events by working with users and acquires stories as knowledge.

We implemented the system in our home-like experimental environment where we installed fifty sensor nodes with acceleration and direction sensors attached to daily objects such as slippers and coffee cups. The environment is also set four microphones and eight cameras.

A. Event detection

Our system contains four kinds of real-time event detectors from data sensed by sensor nodes. The conversation

detector detects periods of speech from microphone signals. The physical-phenomena detector detects objects' movement including falling. The object event detector detects events specific to approximately ten kinds of objects such as opening/closing of doors, cabinets, and drawers. The activity of daily living (ADL) detector [8] uses machine learning to detect roughly 20 kinds of ADLs such as cooking pasta or rice and listening to music.

B. Question answering interaction

When an agent encounters a user, if any event occurred, the agent asks the user about causes of an event while speaking "I have a question." and a question text. The question text is constructed by concatenating "Why", a noun, a verb and the occurrence time information. The touchscreen displays a question text and information about the event and the causal candidates. The user can respond by selecting the answer from causal candidates given on the touchscreen. If there is no right answer, the user inputs an answer with the keyboard.

In order to reduce the burden on users during the input task, the agent presents candidates of causal information. We regarded that a cause should have a high co-occurrence probability. Also, since events are sensed by sensor nodes attached to objects, they have three main elements of "object"(the object attached a sensor node), "action"(the action on an object such as "Move") and "owner"(the owner of an object). Thus, we define a co-occurrence probability as

$$P(A, B) = \prod_e R(A_e, B_e), \quad R(A_e, B_e) = \frac{N_{(A_e, B_e)}}{N_{A_e}}$$

where A is a causal event, B is a result event, e is an element, A_e is A with one element, $N_{(A_e, B_e)}$ is the sum of the number of A_e occurrences within the interval before B_e occurrences, and N_{A_e} is the number of A_e occurrences during a day.

C. Story creation

A method to create stories is that "because" connects a result event and causal information. For example, if the cause of "vacuuming" from 16:20 to 16:30 is "Tom's cup drop" from 16:10 to 16:20, A story is "From 16:00 to 16:30, 'vacuuming' occurred because 'Tom's 'cup_drop' occurred from 16:10 to 16:20." Created stories are compiled in "Story DB". This database becomes agent's knowledge.

V. EXPERIMENT

We evaluate created stories by our system. We perform the experiment under the hypothesis that story creation is in the nature of human intelligence, so people may attribute intelligence to the fact that an artificial agent tells a story if our system can create good stories.

A. Procedure

Six subjects (three males and three females) are office workers in the environmental room as shown in Figure 2. We used Robovie-R Ver.2 [9] as an agent. Subjects were instructed to answer agent's question while passing by the agent. The experimental period ran for eighteen days, during which the system was activated from 10:00 to 18:00. At the end of each

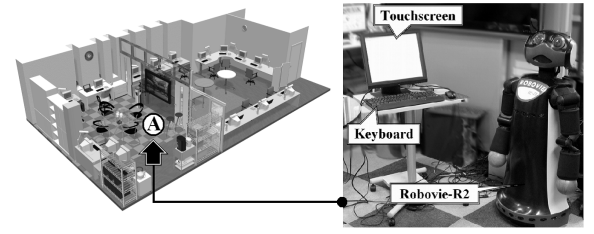


Fig. 2. Experimental setup (agent located on point A)

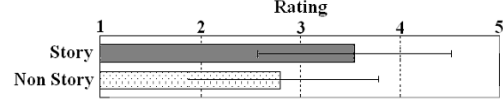


Fig. 3. Average ratings of Intelligence

day, the system made the agent post story and non-story entries to a weblog. The next day, subjects were instructed to read all entries on the weblog and rate each entry by a 5-point scale questionnaire about perceiving agent's intelligence.

B. Result and Discussion

During the experiment, the agent asked 124 questions to users, of which it got 75 causal answers. Figure 3 illustrates questionnaire results. The rating of story entries are higher than non-story and showed significant differences ($p < 0.05$) as the result of Student t-test between the ratings of story and non-story. These results mean our story creation system can create good stories and subjects can feel agent's intelligence strongly by agent's story telling.

VI. CONCLUSION AND FUTURE WORK

In this paper, we investigated a story creation system that supported agents' knowledge acquisition based on human-agent interaction. We presented the method of semi-automatic story creation about daily events detected by ubiquitous sensors and question-answer interaction between human and agent. We obtained subjective results that subjects attribute intelligence to an agent by created stories.

As a next step, acquired knowledge will be applied agents' action such as a conversation with human.

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