Topic Selection for Interactive Robot Based on Knowledge Estimation by Bayesian Network

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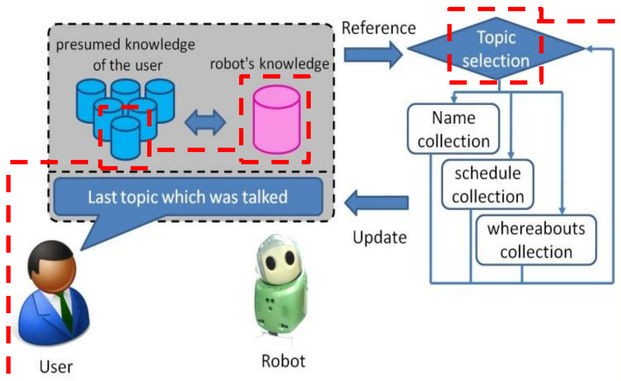
1.Introduction

We think that it is difficult for a user to adjust a schedule of group behavior. Furthermore, if someone misunderstand the schedule, it is still more so. Therefore, we aim at the development of a human-robot system which adjusts a schedule and collects information.

2.The challenges of previous work

i) When a user converts topic suddenly, it is difficult for the robot to follow the topic which was converted.
ii) Robot tells user the information which the user knows.
iii) It was difficult to choose topic flexibly.
iv) The robot could not respond, when there is a disagreement of knowledge between a user and the robot.

3.Methods



[Topic Selection]

The robot always calculates worth of each topic in conversation with a user, and talks the worthiest conversation.

The worth of conversation / The worth of topic / The definitude of information after talking topic *i*

$$V(A_i^u) = \frac{U(A_i^u)}{T(A_i^u)} \cdot R(A_i^u \mid A_k^u) \cdot \mathrm{defH}_i \qquad \mathrm{defH}_i = \frac{(\mathrm{H}_i(t) - \mathrm{H}_i(t+1))}{\max \mathrm{H}_i}$$

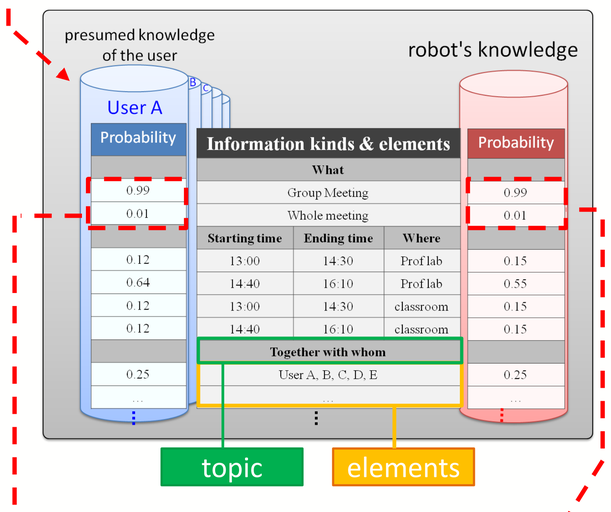
The time required to talk about the topic / The degree of association between last topic and topic i

$$\mathrm{H}_i(t) = -\sum_j^{N_i} P_t(K_{i,j}^u)\log_2 P_t(K_{i,j}^u) - \sum_j^{N_i} P_t(K_{i,j}^r)\log_2 P_t(K_{i,j}^r)$$

$$\max H_i = \log_2 N_i$$

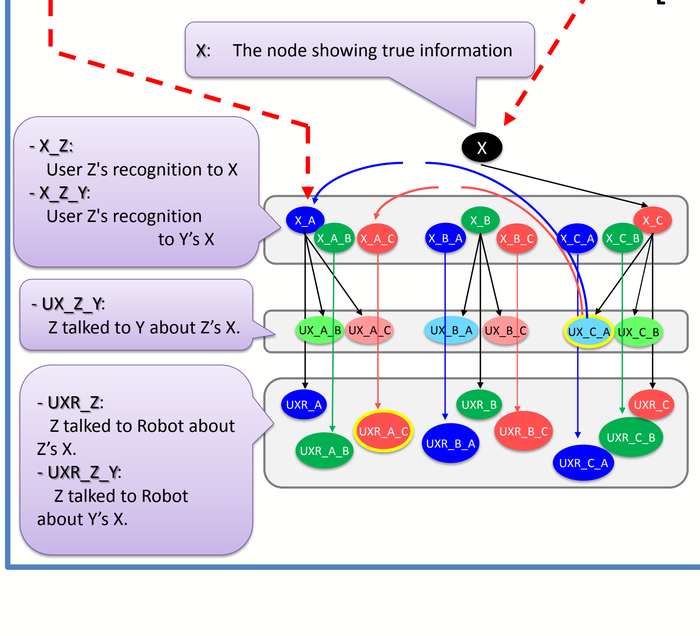
$P_t(K_{i,j}^u)$: Probability that the user considers of the element *j* of topic *i* at time *t*.

$P_t(K_{i,j}^r)$: Probability that the robot considers of the element *j* of topic *i* at time *t*.



[Knowledge state model]

This is a model showing the knowledge state of the users and the robot. This shows the probability that the user thinks that the topic *i* is the element *j*.

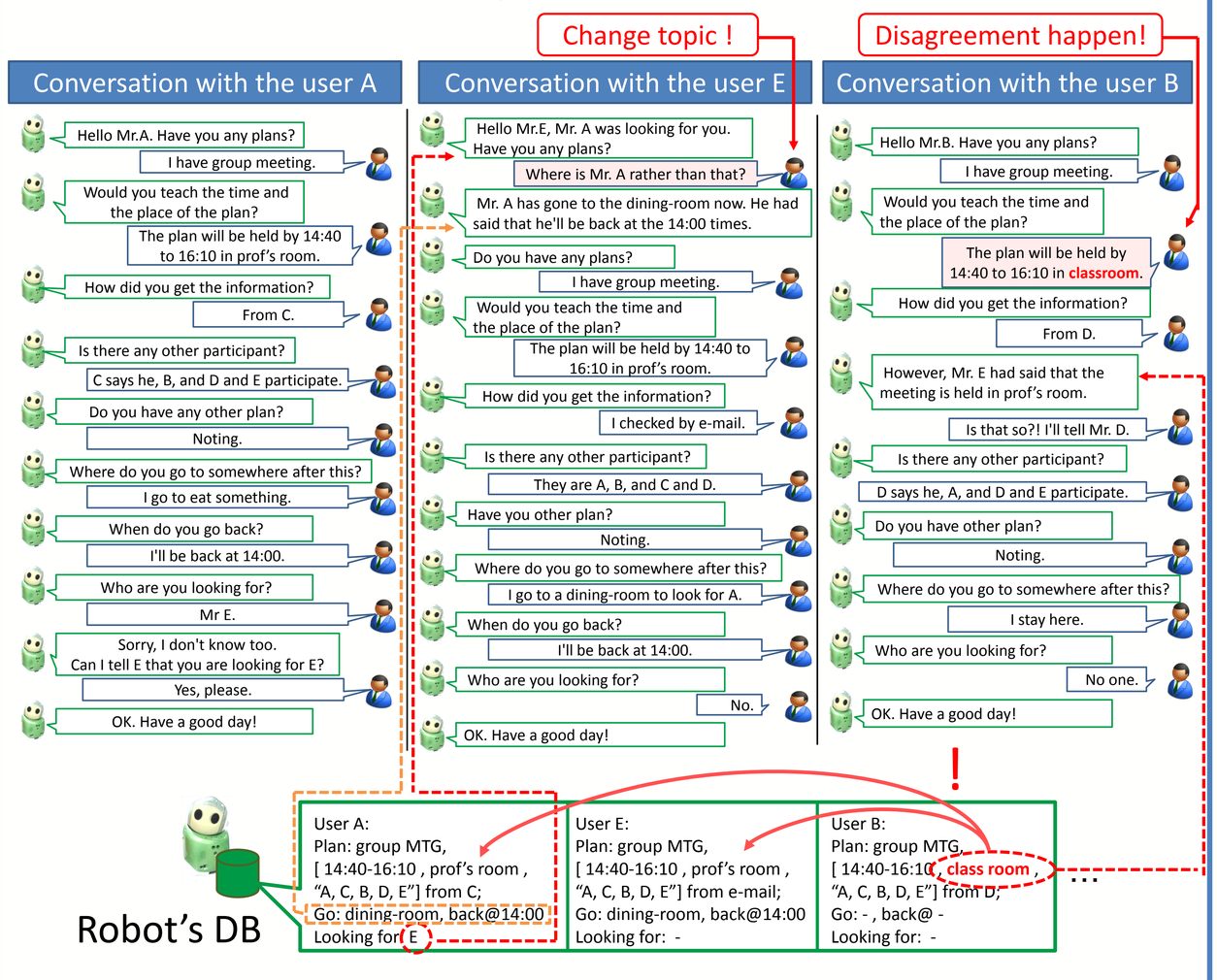


[Knowledge state estimation by Baysian network]

Each node is probability distributions which consist of each element of Topic. Whenever the robot communicate with a user, this Baysian network updates the state of each node. Moreover, a link will be connected if a relation is revealed between each node.

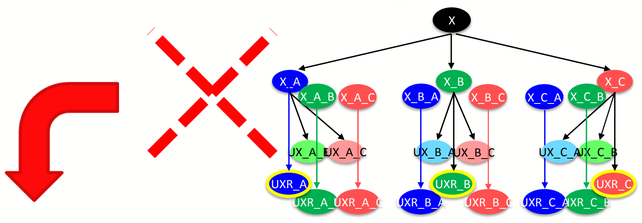
4.Results

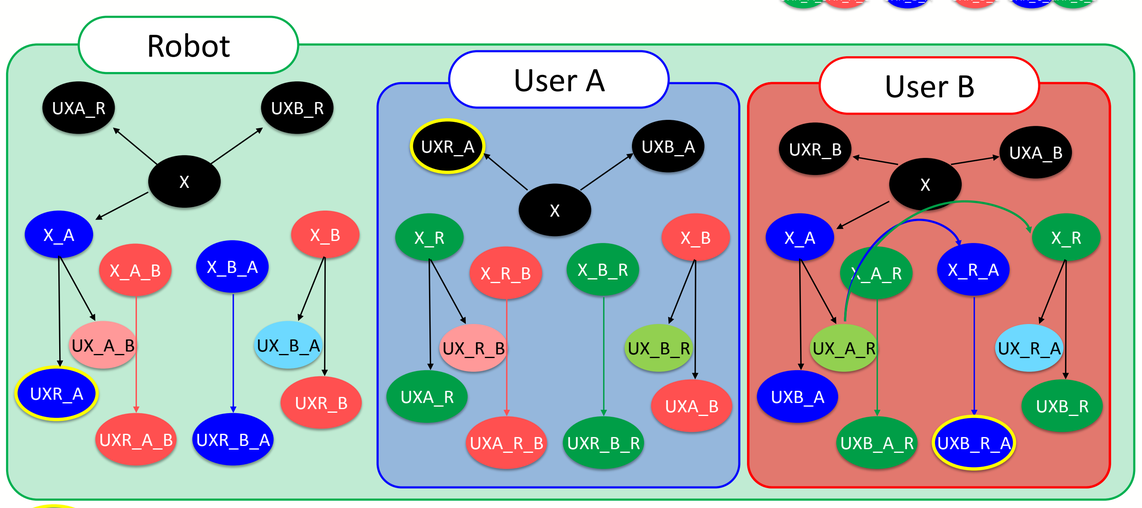
Since the robot has no information, he operates in the mode which collects information. A conversation experimental result is shown below.



5.Current tasks

Since each user's belief is connected by a link, there is a problem by which an unrelated user's belief will also be updated by communication with other users and a robot. In order to solve this problem, I make Basian network for every user and the robot. From now on, I am going to verify this model.





: The node with a yellow frame is a node obtained as a proof.