Learning a Bayesian Network for Situation-Aware Smart Home Service: A Case Study with a Robot Vacuum Cleaner

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Abstract : The smart home environment backed up by IoT (internet of things) technologies enables intelligent services based on the awareness of the situation a user is currently in. One of the convenient sensors for recognizing the situations within a home is the smart meter that can monitor the status of each electrical appliance in real time. This paper aims at learning a Bayesian network that models the causal relationship between the user situations and the status of the electrical appliances. Using such a network, we can infer the current situation based on the observed status of the appliances. However, learning the conditional probability tables (CPTs) of the network requires many training examples that cannot be obtained unless the user situations are closely monitored by any means. This paper proposes a method for learning the CPT entries of the network relying only on the user feedbacks generated occasionally. In our case study with a robot vacuum cleaner, the feedback comes in whenever the user gives an order to the robot adversely from its preprogrammed setting. Given a network with randomly initialized CPT entries, our proposed method uses this feedback information to adjust relevant CPT entries in the direction of increasing the probability of recognizing the desired situations. Simulation experiments show that our method can rapidly improve the recognition performance of the Bayesian network using a relatively small number of feedbacks.

Keywords : Bayesian network, IoT, learning, situation -awareness, smart home