Scopus

Documents

Muhammad, S., Mohammad, N., Bashar, A., Khan, M.A.

Designing Human Assisted Wireless Sensor and Robot Networks Using Probabilistic Model Checking
(2019) *Journal of Intelligent and Robotic Systems: Theory and Applications*, 94 (3-4), pp. 687-709.

Abstract
Wireless sensor networks (WSNs) have a wide variety of applications in environment monitoring (such as air pollution and fire detection), industrial operations (such as machine surveillance), and precision agriculture. It is an arduous task to manage a large WSN as constant monitoring is required to keep it operational. Mobile robots are used to deploy, manage, and perform various application specific tasks in WSNs. However, a fully autonomous robot lacks the ability of proper decision-making in complex situations such as network coverage in disastrous areas. A remote human operator can assist the robot in improved decision-making, specially in odd situations that arise due to either inherent application needs or changes in the environment. In addition to the complexity of WSN managed by a robot, analyzing the effect of human operator in managing WSN poses further challenge. This is due to the fact that the performance of a human operator is also influenced by internal (such as fatigue) as well as external (such as workload conditions) factors. In this paper, we use probabilistic model checking to analyze the performance of robot assisted WSN. This study enables WSN administrators to analyze and plan WSN management before the actual deployment of robot and sensors in the field. Given specific application requirements, we are able to examine key parameters such as size of the network, number of sensors needed to keep the network operational, and time to service the farthest location. With the help of remote human operator, we introduce several degrees of autonomy to the mobile robot managing WSN. Markov decision process is used to capture uncertainties and imperfections in the human−robot interactions. We demonstrate the benefits obtained due to intelligent decision-making by a realistic human operator whose performance is affected by both external and internal factors. We demonstrate the applicability of our approach via detailed case studies in planning and managing WSNs. © 2018, Springer Nature B.V.

2-s2.0-85049564205
Document Type: Article
Publication Stage: Final
Source: Scopus