Using Hidden Markov Chain for Improving the Dependability of Safety-Critical Wireless Sensor Networks

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Abstract : Wireless sensor networks (WSNs) are distributed network systems used in a wide range of applications, including safety-critical systems. The latter provide critical services, often concerned with human life or assets. Therefore, ensuring the dependability requirements of Safety critical systems is of paramount importance. The purpose of this paper is to utilize the Hidden Markov Model (HMM) to elongate the service availability of WSNs by increasing the time it takes a node to become obsolete via optimal load balancing. We propose an HMM algorithm that, given a WSN, analyses and predicts undesirable situations, notably, nodes dying unexpectedly or prematurely. We apply this technique to improve on C. Lius' algorithm, a scheduling-based algorithm which has served to improve the lifetime of WSNs. Our experiments show that our HMM technique improves the lifetime of the network, achieved by detecting nodes that die early and rebalancing their load. Our technique can also be used for diagnosis and provide maintenance warnings to WSN system administrators. Finally, our technique can be used to improve algorithms other than C. Liu's.

Keywords : wireless sensor networks, IoT, dependability of safety WSNs, energy conservation, sleep awake schedule

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