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Evaluating the technical barriers of large scale sustainable wireless sensor network: A resources approach

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ABSTRACT

Increasing environmental concern with societal value results in the new strategy like sustainability, in various fields of applications including operations, management, technology and so along. In the row, in recent years, the integration of sustainability in wireless sensor network hooks the attention of the researchers, which results in the advent of new explorative studies with various outlooks. Nonetheless, still the practitioners facing challenges in the integration of sustainability in Wireless sensor networks (WSN) which has a wide range of day to day applications, particularly in large scale systems, where these challenging issues more common. Hence this paper sought to evaluate the most essential barrier which resisting the sustainable WSN strategy in large scale systems through the assistance of the proposed framework and this framework gets legalized with structural health monitoring application in which the previous studies failed. The most common barriers are collected from the literatures and validated with the practitioners and technical experts, further analyzed with the assistance of the case organization which is considered their structural health monitoring using WSN. The organization players are considered as decision makers and their replies are analyzed through the multi-criteria decision making tool, AHP (Analytical Hierarchy Process). The results revealed the most essential barrier among the common barriers of sustainable WSN, with these weights, the practitioners can easily address and eradicate the most effective barrier rather than wasting time with less essential barriers of sustainable WSN. Consequently, this study provides both scientific and societal contribution by addressing one of key area in WSN, large scale sustainability.

1. Introduction

Integration of computer applications, increase by day to day applications which results in various advancements in technology through the application of defense, communication, industrial data processing and so on. Among these applications, communication play a vital role in all scenario, in recent trend communication sectors are got its peak which not only limited with sending messages but also to monitor. In such monitoring, in recent years wireless sensor networks has a strong hands, wireless sensor nodes are the computational devices which furnished with the bunch of activities like sensing, processing, communicating abilities and so on, when these numerous wireless sensor nodes are meshed to form a wireless sensor networks (Tan and Panda, 2010). The WSN architecture which is shown in Fig. 1 consists of sensor nodes, public networks, sink, manager nodes and finally the end user (Akyildiz et al., 2002). However the origin of the WSN get started with the motto of military surveillance applications (Chong and Kumar, 2003), further it extended its applications in various fields which includes medical applications (health care monitoring), environmental applications (air pollution monitoring, forest fire detection, landslide detection, water quality monitoring, natural disaster prevention and chemical agent detection), Industrial applications (machine health monitoring, data logging, waste water monitoring) and structural applications (structural health monitoring).

Even though it has lot of application in various fields but still there are many limitations are encountered such as computing power, memory space, lifetime prolongation, coverage and so on (Wang et al., 2012). Earlier, conventional WSN only focus the economical profit, but in the comtemporary research and resources trends, only economical advantage never yield full benefits, hence a new energy efficient approach was integrated with WSN, to make the conventional WSN as sustainable WSN. Hence many studied engage themselves to dig out more beneficiaries

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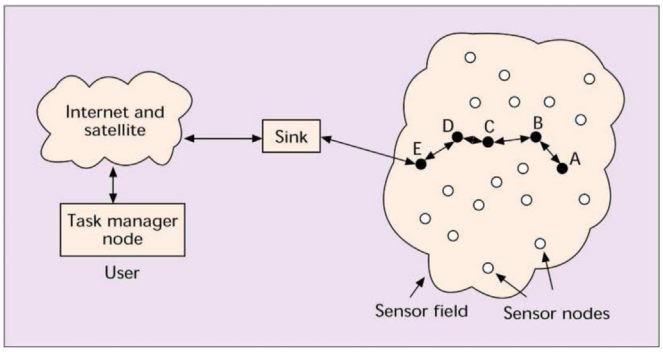

Fig. 1. Architecture of WSN (Akyildiz et al., 2002).

from WSN in minimal input with results in various strategies like optimal cluster selection (Thein and Thein, 2010), energy harvesting and efficient in WSN (Semente et al., 2015; Hoang et al., 2014; Zhou et al., 2013) and so on. In the row, sustainable WSN get a huge hike among researchers which results in emerge of new studies in the field of sustainable WSN. The concern of sustainability in WSN, not only deserves the energy efficient but also assist to increase the life span of WSN (Zhou et al., 2013). The main aim of the sustainable WSN is to harvest energy under the concern of renewable energy sources, but it is a very tough task to implement rather than proposed conceptually. But no previous studies analyze these challenges involved in the implementation of sustainable WSN, some studies (Zhou et al., 2013; Fafoutis et al., 2013) do exploit the concepts of sustainable WSN but limited with the challenges. Hence this study, take itself the responsibility to evaluate the effective barrier of sustainable WSN implementation. Once the concept of problem was cleared then it is time to go for field of application, normally these sustainable issues are more experienced in large scale than any other. Hence this study focussed on large scale health monitoring application. Also, most of the studies (Tan and Panda, 2010; Fafoutis et al., 2013; Kurata et al., 2006) argued that the application of WSN is likely more important in structural health monitoring. Hence this study chose to evaluate the essential barrier of sustainable WSN in large scale structural health monitoring. As per the previous discussions it is clearly evident that the sustainable WSN is complex problem with various tangible and intangible factors and also according to Shen et al. (2015) the multi-criteria decision making is the best tool for addressing these complex factor problems, hence this study chose the MCDM approach to solve this problem. Among MCDM, there are various tools exist to identify the weight of the criteria, but this study consider the Analytical hierarchy process (AHP) because according to van de Kaa et al. (2014) it is one of the robust tool to solve the problem with wider application.

1.1. Framework of the study

So as to attain the intention of the research, the model framework was proposed as three phase methodology of the

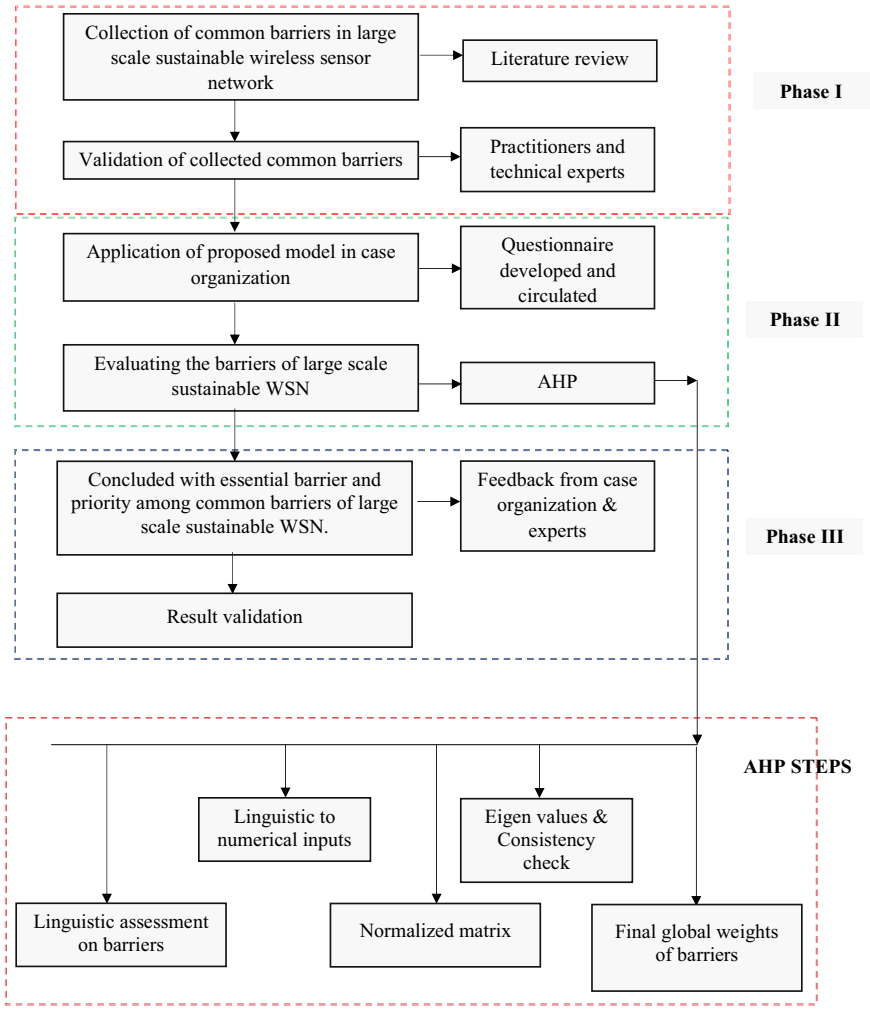

Fig. 2. Proposed Framework of the study.