ENERGY EFFICIENT IN CLUSTER HEAD AND RELAY NODE SELECTION FOR WIRELESS SENSOR NETWORKS

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Thesis submitted in fulfillment of the requirements
for the award of the degree of
Doctor of Philosophy

Faculty of Computing

UNIVERSITI MALAYSIA PAHANG

JUNE 2021

ACKNOWLEDGEMENTS

In the name of Allah, the Entirely Merciful, the Especially Merciful.

First and foremost, I am greatly indebted to my supervisor, Associate Professor Dr. Mohd Nizam Mohammad Kahar, for all his encouragement, guidance, direction, dedication and invaluable support, throughout my PhD study at Universiti Malaysia Pahang (UMP). Without his support and encouragements, I cannot go so far. I would like to thank him for his patient guiding and inspiring throughout my study period. My co-advisor, Dr. Wan Isni Sofiah Wan Din, for her insightful advices, ideas and suggestion during these past three years.

Also, I also would like to acknowledge to UMP Fellowship for the financial support in my PhD study. I would like to take this opportunity to thank UMP for funding in my research works. Thanks also to all friends and staffs in Faculty of Computing. They have been the best part of this multi-year journey. Your refreshing energy contributed a lot to completion of this thesis.

Finally, my heartfelt thanks to my beloved parents, my dearest wife Nur Farhana, and my wonderful kids. Encouragement for completion of this thesis is just the tip of your never-ending guidance and love.

ABSTRAK

Rangkaian Pengesan Wayarles (WSNs) di definasikan sebagai rangkaian nod yang berinteraksi di antara satu sama lain untuk mengesan dan mengawal keadaan persekitaran. Namun begitu, nod mempunyai tenaga yang terhad di mana ia menjadi limitasi utama untuk operasi rangkaian pengesanan. Dalam senibina WSNs, nod dikumpulkan di dalam satu kluster di mana terdapat satu nod akan dipilih sebagai Ketua Kluster (CH) dan penggunaan nod geganti untuk meminimakan penggunaan tenaga. Pada masa sekarang, pemilihan CHs menggunakan gabungan beberapa pemboleh ubah input. Contoh pemboleh ubah input yang digunakan adalah seperti sisa tenaga, kos komunikasi, kepadatan nod, mobility, saiz kluster dan lain-lain. Pemilihan nod yang tidak sesuai (i.e. nod dengan signal yang rendah) untuk dijadikan sebagai CH boleh menyebabkan peningkatan penggunaan tenaga. Tambahan lagi, penghantaran di antara nod dan stesen pangkalan (BS) menggunakan komunikasi dua lompatan menggunakan tenaga yang tinggi. Pemilihan nod geganti yang sesuai dapat membantu di dalam komunikasi untuk mengurangkan penggunaan tenaga. Oleh yang demikian, matlamat utama kajian adalah untuk memanjangkan jangka hayat rangkaian (i.e. mengurangkan penggunaan tenaga) dengan menambahbaik pemilihan CH and nod geganti melalui beberapa gabungan pemboleh ubah yang baru beserta pendekatan jarak ambang. Untuk pemilihan CH, skim kekuatan penerimaan signal (RSSI), keumpukan dan tenaga sisa nod telah diperkenalkan. Logik kabur digunakan untuk memilih CH yang bersesuaian berdasarkan pemboleh ubah tersebut di dalam MATLAB. Untuk pemilihan nod geganti pula, pemilihan adalah berdasarkan jarak ambang yang memendekkan jarak dengan BS. Pemilihan jumlah nod geganti yang optimum dilakukan menggunakan teknik K-Optimal dan K-Means. Ini bagi memastikan semua CH disambungkan sekurang-kurangnya pada satu nod geganti untuk menghalakan data ke BS. Untuk menilai pendekatan yang dicadangkan, Protokol Pelbagai Lapisan (MAP) and Protokol Pemilihan Stabil (SEP) telah dibandingkan berdasarkan 100, 200 dan 800 bilangan nod beserta tenaga 1 J dan tenaga rawak. Hasil keputusan simulasi menunjukkan pendekatan yang diperkenalkan iaitu kecekapan tenaga untuk pemilihan CHs and nod relay (EECR), dapat memanjangkankan jangka hayat rangkaian sebanyak 43% and 33% berbanding SEP dan MAP. Tesis ini dapat merumuskan dengan gabungan pemboleh ubah yang sesuai dan pemilihan nod geganti yang efektik dalam persekitaran nod yang statik, ia dapat meningkatkan kecekapan penggunaan tenaga pada rangkaian WSNs.

ABSTRACT

Wireless Sensor Networks (WSNs) are defined as networks of nodes that work in a cooperative way to sense and control the surrounding environment. However, nodes contain limited energy which is the key limiting factor of the sensor network operation. In WSN architecture, the nodes are typically grouped into clusters where one node from each cluster is selected as the Cluster Head (CH) and relays utilisation to minimise energy consumption. Currently, the selection of CH based on a different combination of input variables. Example of these variables includes residual energy, communication cost, node density, mobility, cluster size and many others. Improper selection of sensor node (i.e. weak signal strength) as CH can cause an increase in energy consumption. Additionally, a direct transmission in dual-hop communication between sensor nodes (e.g. CH) with the base station (BS) uses high energy consumption. A proper selection of the relay node can assist in communication while minimising energy consumption. Therefore, the research aim is to prolong the network lifetime (i.e. reduce energy consumption) by improving the selection of CHs and relay nodes through a new combination of input variables and distance threshold approach. In CH selection, the Received Signal Strength Indicator (RSSI) scheme, residual energy, and centrality variable were proposed. Fuzzy logic was utilized in selecting the appropriate CHs based on these variables in the MATLAB. In relay node selection, the selection is based on the distance threshold according to the nearest distance with the BS. The selection of the optimal number of relay nodes is performed using K-Optimal and K-Means techniques. This ensures that all CHs are connected to at least one corresponding relay node (i.e. a 2-tier network) to execute the routing process and send the data to BS. To evaluate the proposal, the performance of Multi-Tier Protocol (MAP) and Stable Election Protocol (SEP) was compared based on 100, 200, and 800 nodes with 1 J and random energy. The simulation results showed that our proposed approach, refer to as Energy Efficient Cluster Heads and Relay Nodes (EECR) selection approach, extended the network lifetime of the wireless sensor network by 43% and 33% longer than SEP and MAP, respectively. This thesis concluded that with effective combinations of variables for CHs and relay nodes selection in static environment for data routing, EECR can effectively improve the energy efficiency of WSNs.

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