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Power Optimization Using Proposed Dijkstra's Algorithm in Wireless Sensor Networks

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Abstract: WSN refers to a group of spatially spread and dedicated sensors for watching and recording the physical conditions of the surroundings and organizing the collected information at a central location. Wireless device Networks (WSNs) give a brand new paradigm for sensing and scattering info from varied environments, with the potential to serve several and numerous applications. Current WSNs usually communicate directly with a centralized controller or satellite. On the opposite hand, a sensible WSN consists of various sensors spread across a geographical area; every sensor has wireless communication capability and sufficient intelligence for signal process and networking of the information. The structure of WSNs area unit tightly application-dependent and lots of services are smitten by application linguistics (e.g. application-specific processing combined with information routing). Thus, there's no single typical WSN application, and dependency on applications is over in ancient distributed applications. Therefore, besides the well explored power management techniques on the transceiver activity and wireless transmission, there's a necessity to instigate additionally the ability management on the sensing unit that reduces the power consumption of the power-hungry sensors. In this paper, we provide a proposed method for power optimization in WSN. In the proposed method, we are using Dijkstra's algorithm to reduce the power consumption and finding the shortest power consumed path between Source to Destination using minimum number no nodes.

Keywords: WSN, power optimization, power hungry sensors, distributed sensing, power optimization methods.

1. INTRODUCTION

The need to monitor and measure various physical phenomena (e.g. temperature, fluid levels, vibration, strain, humidity, acidity, pumps, generators to manufacturing lines, aviation, building maintenance and so forth) is common to many areas including structural engineering, agriculture and forestry, healthcare, logistics and transportation, and military applications. Wired sensor networks have long been used to support such environments and, until recently, wireless sensors have been used only when a wired infrastructure is infeasible, such as in remote and hostile locations. But the cost of installing, terminating, testing, maintaining, trouble-shooting, and upgrading a wired network makes wireless systems potentially attractive alternatives for general scenarios. Recent advances in technology have made possible the production of intelligent, autonomous, and energy efficient sensors that can be deployed in large numbers to form self-organizing and self healing WSNs in a geographical area. Moreover, the dramatic reduction in the cost of this wireless sensor technology has made its widespread deployment feasible, and the urgent need for research into all aspects of WSNs has become evident.

The WSN has great, long- term potential for transforming our daily lives, if we can solve the associated research problems. The sensors that, when distributed in the environment, comprise WSNs include cameras as vision sensors, micro- phones as audio sensors, and those capable of sensing ultrasound, infra-red, temperature, humidity, noise, pressure and vibration. Although the individual sensor's sensing range is limited, WSNs can cover a large space by integrating data from many sensors. Diverse and precise in- formation on the environment may thus be obtained. Sensor networks are an emerging computing platform consisting of large numbers of small, low-powered, wireless motes each with limited computation, sensing, and communication abilities.

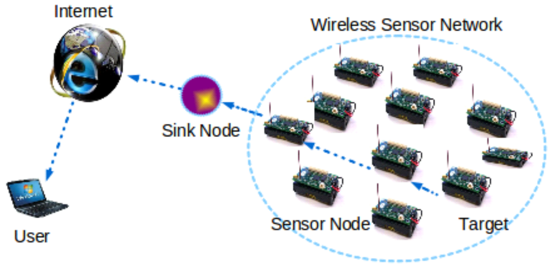

Fig 1: WSN Overview

It is still a challenge to realize a distributed WSN comprising: small and cost effective sensor modules; high speed, low latency and reliable network infrastructures; software platforms that support easy and efficient installation of the WSN; and sensor information processing technologies. Unfortunately, little of this software carries over directly from one application to an-other, since it encapsulates application-specific tradeoffs in terms of complexity, resource usage, and communication patterns. No WSN application will therefore be seen as typical, and application-dependency will be higher than in traditional distributed applications. Recent WSN research has focused increasingly on the application layer and an API at an appropriate abstraction level is needed urgently.

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Such an API would hide from programmers the complexities of sensor nodes and routing. The middleware technology must provide such an abstract API. In WSNs, the task of middleware is to collect large amounts of data from sensors, and/or on the movement of sensors. It must then perform aggregation and management of data in appropriate formats for the target distributed applications.

1.1 Characteristics of Sensor Node

Energy –efficiency-Energy is scarcest resource that must be used properly as a result of it's not {possible} to recharge every node thus it must be energy economical as possible as. Low-cost-As it's assortment of hundred and thousands sensor nodes, thus value of every node ought to be node minimum so overall value of network ought to even be minimum. Distributed-Sensing-As massive numbers of node are distributed in sensor network thus every node will capable of grouping and storing data. So distributed sensing provides strength to the system. Wireless-Sensor node ought to be wireless as several application don't require/ install infrastructure for communication. In that case, sensor node can use wireless communication channel. Multi-hop-As large amount of sensor nodes are deploying in WSN, thus it's not possible for every node to achieve the base-station. It's going to be need intermediate node to achieve the base- station. Thus, the answer is multi-hop. Distributed processing-Each node in WSN will collect and process native data, perform aggregation on same data then transmitting it to data [1]. Node Types- In sensor network, on the premise of sensing vary essentially 2 types of group of node exists- Homogeneous group of node and heterogeneous group of node. A Group in which all nodes are identical and have same capability is known as homogeneous group of node. Example of homogeneous group is layered architecture. On the opposite hand, a group in which all the nodes don't seem to be identical and don't have same capability i.e. some node are a lot of powerful than others. Example of heterogeneous group is cluster architecture in which node forms a cluster head and gather information from less powerful node [2]. Application-oriented- as a result of the wireless nature of sensor network, they're employed in major kind of application like military, environmental and health care etc. Nodes are deployed indiscriminately and spanned relying upon the sort of application used. Small Size node- sensor nodes are usually tiny in size wherever vary of every node is restricted concerning 30m. As a result of tiny size of node; energy is restricted that makes processing capability low. Dynamic Network Topology- Principally sensor nodes are deployed within the infrastructure less area, as a result the network topology continually changes as a result of the addition of new nodes, failure of nodes, and mobility. So, it's a awfully difficult task to take care of the topology of sensor network. [3, 4, 5].

1.2 Application Potentials

Depending upon the requirement and characteristics of system, wide variety of applications are there which require constant monitoring and detection of specific event. Military Applications- Sensor networks are applied very successfully in the military sensing. WSN can be an integral part of military command, control, communications, computing, intelligence, surveillance, reconnaissance and targeting systems, detection of mass destruction and explosion and enemy movement, Biological, nuclear and chemical attack detection reconnaissance and military situation Awareness. Environmental Applications- Nowadays sensor networks are also widely applied in habitat monitoring, agriculture research- include sensing of pesticide, soil moisture, PH levels, habitat Exploration of Animals, forest Fire and Flood detection, traffic control and ocean monitoring includes monitoring of fish. Structural health monitoring- Health monitoring is a very hot research topic for industry and academia. The amount of raw data that can be gathered and transported for such application is of the order of 1-10 Mbps. Thus only useful information is transmitted by using complex algorithms like wavelet transformation, auto regressive models etc. Heavy industrial monitoring- Industrial applications require highly reliable operation in harsh environment, in warehousing, industrial applications, manufacturing monitoring, industrial automation and factory process control. Health or Medical Applications- Sensor networks are also widely used in health care such as monitoring patient physiological data such as blood pressure or heart rate, to control the drug administration, unconsciousness detection, exercise monitoring and non-invasive health monitoring. Home Application- Home application will step into our normal life in the future. In home application, sensor node can be embedded into furniture and home appliances, monitoring product quality, managing and monitoring inventory system and automatically control the temperature and airflow of the room [6, 7, 8, 9, 10, 11, 12].

1.3 Architecture Design Objectives

Identifying Requirements for Typical Sensor Node Application- On the idea of target application a brand new design will be developed associate degreed just in case of sensor network it's vital to search out the character of future detector Node applications however chemical analysis of an application can greatly offer identification of a lot of correct design goals. Identifying Relevant Technological Trends - WSN systems are heterogeneous and sophisticated, so it's vital to estimate the design and price bottlenecks and which of them are resolved because of technological progress. Importance of technological trends is very important throughout design architecture for maximize the power optimization. Depending on future ratios of computation, communication and storage value, terribly differing types of algorithms are developed for WSN. Balanced Design- For the most utilization sensor node, it's vital to optimize each and every part of sensor node to the maximum extend. Techniques for Design and usage of the Components- The parts of WSN node will be grouped into two classes consistent with their maturity. Power supplies, especially, storage and power suply, area unit thought-about as mature technologies. On the

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opposite hand, immoderate low power wireless communication, sensors, and actuators are technologies looking ahead to major technological revolutions. It's vital to spot that techniques, architectures, and tools will be reused and wherever the new style effort is needed. Survey of technology, components and sensor nodes- Special focus of detector node design is to produce each, qualitatively and measurement. For this, we tend to should think about the state-of-sensor nodes, technology and parts so value call for planning the architecture [13].

2. WIRELESS SENSOR NETWORKS

A WSN may be a assortment of millimetre-scale, self-contained, micro-electro-mechanical devices. These small devices have sensors, procedure process ability (i.e. CPU power), wireless receiver and transmitter technology and an power supply. In an exceedingly WSN, an oversized range of sensor nodes typically span a physical geographical region. For instance, the prototype of a future sensor node (mote) within the Smart Dust project [14], performs the wireless communication function, the sensor function, the power supply unit, and the information processing function on the MEMS (Micro Electro Mechanical System) chip, that features a scale solely of many millimetres. Typical WSNs communicate directly with a centralized controller or a satellite, so communication between the sensor and controllers relies on single hop. In future, a WSN may be a set of autonomous nodes or terminals that communicate with one another by forming a multi-hop radio network and maintaining property in an exceedingly redistributed manner by forming an ad-hoc network. Such WSNs might modification their topology dynamically once connectivity among the nodes varies with time due to node quality

2.1 WSNs vs. MANETs

There are 2 major forms of wireless ad hoc networks: mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs). MANET is associate degree autonomous assortment of mobile routers (and associated hosts) connected by bandwidth-constrained wireless links. Every node is visualised as a private information appliance like a personal digital assistant (PDA) fitted out with a reasonably subtle radio transceiver. The nodes are totally mobile. The network's wireless topology might change erratically. Such a network might operate in an exceedingly complete fashion, or could also be connected to the larger internet. A WSN will be deployed in remote geographical locations and needs smallest setup and administration prices. WSNs differ from MANETs in several elementary ways. Viewing a WSN as a large-scale multi-hop ad hoc network might not be applicable for several real-world applications. The communication overhead for configuring the network into associate degree operational state is just too massive. The quantity of nodes in an exceedingly WSN will be many orders of magnitude more than the nodes in ad hoc network and sensor nodes that square measure liable to failure square measure densely deployed. Sensor nodes primarily use broadcast, whereas most Manet's square measure supported the Peer-to-Peer (P2P) communication paradigm. Information exchange between end-to-end nodes is rare in WSNs. They're restricted in power, process capability and memory, and will not have global IDs. WSNs have a good vary of applications starting from observance environments, sensitive installations, and remote information assortment and analysis. In each MANETs and WSNs, the nodes act as both hosts and as routers. They operate in an exceedingly self organizing and adapting manner. Analysis and development within the areas of infrastructure less wireless networks are advancing at a quick pace, and a lot of effort has to be dedicated during this direction for wide scale adoption and deployment. Current sensor hardware is resource and power affected, however evolution of hardware and price reduction are improve rapidly. WSNs might eventually share the properties of MANETs.

3. PROBLEM STATEMENT

The objective of this work is to minimize the energy consumption in the network using shortest path problem or shortest power consumption path.

In the proposed method, we are using Dijkstra's algorithm to reduce the power consumption and finding the shortest power consumed path between Source to Destination using minimum number no nodes.
The general objectives can be outlined as follows:

* Taking same number of nodes for existing method and for proposed method.
* Same cost & weight for both the methods.
* Calculating the shortest path by both the methods.
*Comparing the results of both the methods.

3.1 Proposed power optimization methods

Life time of sensor node mainly depends on battery power. There are mainly 2 types of batteries:

*Primary
*Secondary

Primary batteries are not rechargeable e.g. Zinc-air and lithium whereas secondary batteries are rechargeable e.g. NiMHd and NiCd.

*To increase the lifetime of nodes we have some solutions:

1) Use Secondary battery
It is not possible to recharge the primary batteries so we use secondary batteries but it is difficult to recharge them in remote areas.

2) Use two different modes
Two different modes i.e. ACTIVE or SLEEP

* In ACTIVE mode, node continuously senses the incoming data. Hence, more power is consumed.

* When a node is in IDLE state i.e. not transmitting data, it can be switched to sleep mode.

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Switching from ACTIVE mode to SLEEP mode and SLEEP mode to Active mode also consumes battery power.

3) Power Optimization using an efficient routing algorithm that finds the optimal path between Source to Destination.
* If current battery power of present node is less than the required for transmission then leave this node and neglect the existing loops in the network or graph, if available. Also choose the shortest path between nodes (Source to Destination), if we can reach from Source to Destination in same cost with two different paths P1 & P2 then select the minimum path weight as well as minimum node between Source to Destination.

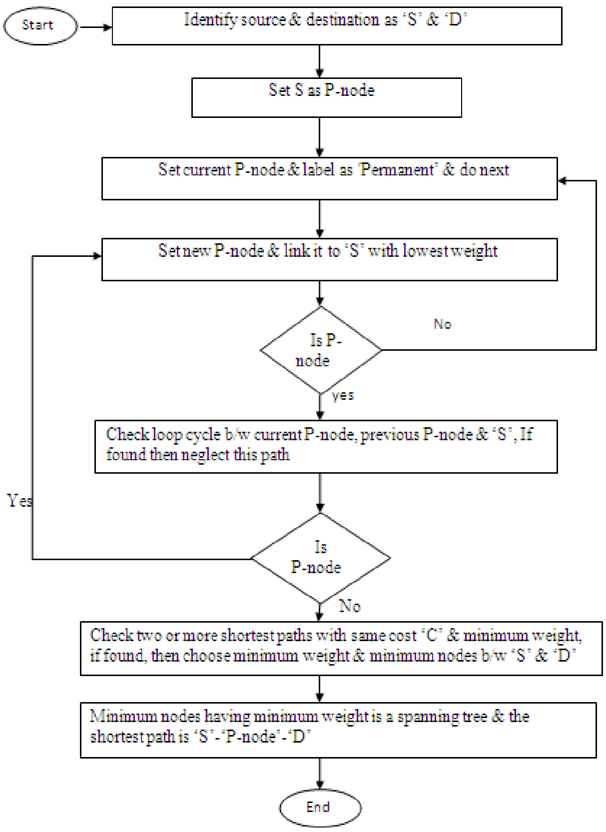
3.2 Proposed Dijkstra's Algorithm

1. Choose a network area with sensor nodes.
2. Identify source and destination node as S & D.
3. Fix source node as P-node(permanent node)
4. Search nearest sensor node. Set it current P-node, label permanent & do next.
5. Set new P-node & link it to current p-node with lowest weight.
6. Check loop between current P-node, previous P-node and source 'S'. If found neglect this path and go back to step 4.
7. Check two or more shortest paths with same cost C & minimum total weight of path. If found then choose minimum nodes between 'S 'to 'D'.
8. Fix destination 'D' as P-node.
9. Spanning tree having minimum cost & minimum nodes of network and the path of spanning tree is a best way to save power in WSN.

3.3 Pseudo code for the proposed algorithm

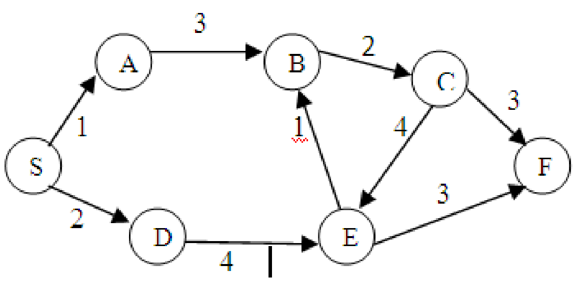
```
 function Dijkstra (Network, source):
{
 Network= n; Source= S;
 Nodes Pr, C;
 Initialize S.dist=0;                                   //
Distance from source to source
dist of other nodes= ∞;
 While (check existing unknown nodes)
{
  if (C==smallestdist)                                  //
C defines current node
{
  C. known=true;
  C=P-node;
// P-node defines Permanent node
  }
 For each next-node adjacent to P-node
  if( !N.known)                                         //
N defines next node
 {
  else if (C. dist+ cost_C.N< N. Dist)
 {
   decrease (N.dist= C.dist+ cost_C.N< N.dist);
     N.path= C;
     C= P-node
 }
Else if (N.path= C, Pr)
{
Set Min_cost( N.path)
    }
   }
  }
 }
```

3.4 Flow chart



4. RESULTS AND ANALYSIS

The proposed method of increasing the lifetime of nodes mainly depends on the battery usage. In the proposed method, if we can reach from Source to Destination in same cost with two different paths P1 & P2 then select minimum path weight as well as minimum nodes between Source to Destination.



* Paths between Source to Destination:

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There are four possible paths between Source to Destination.

1) S, A, B, C, F
2) S, A, B, C, E, F
3) S, D, E, B, C, F
4) S, D, E, F

According to Dijkstra's algorithm

Identify the Source and Destination as 'S' & 'D'. Set 'S' as permanent node(p-node) and select the next node linked with 'S', having minimum weight. Set current P-node & label permanent & do next.
Starting from 'S' link it to 'A' as 'A' is having minimum weight then link 'A' to 'B'. Then link 'B' to 'C'. At last, join 'C' to 'F'. So according to Dijkstra's algorithm, path {S, A, B, C, F} is selected.
Cost of path{S, A, B, C, F} is 9 i.e. minimum cost and number of nodes used are 5.

According to proposed algorithm

Proceed accordingly in this case too. Set new P-node and link it to 'S' with lowest weight. After that, check loop cycle between current P-node, previous P-node and 'S', if found then neglect this path. If no cycle is found then check for two or more shortest paths with same cost 'C' and minimum weight, if found then choose minimum weight and minimum nodes between Source to Destination.
Minimum nodes having minimum weight is a spanning tree and the shortest path is 'S'-p-node-'D'.
Paths with minimum cost are:
S, A, B, C, F and S, D, E, F. Both are having same cost i.e. 9.
So according to proposed scheme, we should select{S, D, E, F} path because minimum nodes are there between 'S' and 'F' i.e. 4.

4.1 Comparison

Algorithm	Minimum Cost of paths	No. of Nodes used in diff. paths	No. of Nodes used in selected paths
Dijkstra's algorithm	9	5, 4	5
Proposed algorithm	9	4	4

Table 1: Comparison b/w Dijkstra's & proposed algorithm

5. CONCLUSION

Using proposed algorithm, power usage or energy requirement is minimized as less number of nodes are used for transmitting the data in the network. Nodes are power hungry. So, as less number of nodes are used for transmitting the data in the network, less energy will be consumed by the sensor nodes.

REFERENCES

[1] Macros Augusto m. Vieira, Diogenes Cecilio da Silva Junior, "Survey on wireless sensor network devices" cpna 2002- 2009.
[2] Raymond Mulligan, Habib M.Ammari :Coverage in Wireless Sensor Networks: A Survey"Network Protocols and Algorithms ISSN 1943-3581 2010, Vol. 2, No. 2.
[3] Sasha Slijepcevic, Ranjit Iyer, Michael Panossian," A Survey of Wireless Sensor Networks".
[4] Kay R¨omer and Friedemann Mattern," The Design Space of Wireless Sensor Networks", partly supported by NCCR-MICS and centerly supported by Swiss science foundation under grant no.5005-67322, IEEE wireless communications.Dec 2004.
[5] Michał Marks "A Survey of Multi-Objective Deployment in Wireless Sensor Networks", Journal of telecommunications and information technology, published in 2010.
[6] I.F. Akyildiz, W.Su, Y. Sankarasubra-maniam, E. Cayirci, "Wireless Sensor Networks: A Survey", IEEE commun. Mag., published by Elsevier Science B.V. in 2002.
[7] Toh. C.K., 2002, "Ad-hoc Mobile Wireless Networks Protocols and Systems" , Prentice Hall, Inc.
[8] Jennifer Yick, Biswanath Mukherjee, Dipak Ghosal "Wireless sensor network survey", Computer Networks 52 (2008) 2292–2330.
[9] Chiara Buratti, Andrea Conti, Davide Dardari and Roberto Verdone"An Overview on Wireless Sensor Networks Technology and Evolution, Sensors 2009, 9, 6869-6896; doi:10.3390/s90906.
[10] Eiko Yoneki, Jean Becon," A Survey of Wireless Sensor Network Technologies: research trends and middleware's role", technical report published by
[11] Kazi Chandrima Rahman, "A Survey On Sensor Network" , ISSN 2218- 5224, Vol. 01,ISSUE 01, published in 2010.
[12] Ying Miao, "Application of sensor networks", seminar on self-organization networks, Faculty of engineering Science, Delivered on Monday 02-05-2005.
[13] Jessica Feng, Farinaz Koushanfar*, and Miodrag Potkonjak, " Sensor Network Architecture", supported by the mational science foundation under Grant No. NI-0085773 and NSF CENS Grant
[14] Satyanarayanan, M. et al. Of Smart Dust and Brilliant Rocks. IEEE Pervasive Computing, Vol.2, No.4, pp.2-4, 2003.