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MULTILAYERED ENERGY OPTIMIZATION ALGORITHM FOR PERFORMANCE ENHANCEMENT IN WIRELESS SENSOR NETWORKS

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ABSTRACT

Wireless sensor network refers to the communication without specific infrastructure in which the nodes or simply motes communicate and transfer data via base station. Once the data is fetched and verified by the base station, then the filtered and approved information is sent to the satellite for taking the appropriate actions. There are number of fields in WSN which are under research including energy optimization, energy harvesting, security of motes, cryptography, energy transfer, scheduling and many others. Still the domain of energy optimization is one of the most touched areas as the wireless sensor nodes are susceptible to higher energy loss during the transmission. In this research work, an effective technique to preserve and save the energy in wireless sensor networks is presented, implemented and explained by which the huge energy loss can be avoided. The proposed technique is making use of the multiple base stations and the distance based approach is used. In this approach, the nearest base station is delivered the data packets by the cluster head and then the energy is optimized. The proposed results are giving efficient results in terms of overall energy preserved, cost factor and efficiency of the network.

Keywords - Energy Optimization, Wireless Sensor Network, Energy Harvesting

INTRODUCTION AND FOREWORD

The wireless sensor network [1] or simply WSN is a cluster of specialized transducers having the communications infrastructure for monitoring and recording conditions at assorted locations. Commonly monitored parameters are temperature, humidity, pressure, wind direction and speed, illumination intensity, vibration intensity, sound intensity, power-line voltage, chemical concentrations, pollutant levels and vital body functions.

A sensor network consists of multiple detection stations called sensor nodes, each of which is small, lightweight and portable. Every sensor node is equipped with a transducer, microcomputer, transceiver and power source. The transducer generates electrical signals based on sensed physical effects and phenomena. The microcomputer processes and stores the sensor output. The transceiver receives commands from a central computer and transmits data to that computer. The power for each sensor node is derived from a battery.

The assorted applications of the wireless sensor networks includes Process Management, Health Care, Volcano Monitoring, Disaster Management, Data Logging, Music Technology, Industrial automation, Automated and smart homes, Video surveillance, Traffic monitoring, Medical device monitoring, Monitoring of weather conditions, Air traffic control, Robot control and many others

The key attributes of wireless sensor networks include the utilization of power imperatives for hubs utilizing power devices or vitality reaping , Capacity to adapt to nodes disappointments (strength), Versatility of the nodes, Heterogeneity of the nodes, Versatility to huge size of sending , Capacity to withstand cruel natural conditions , Convenience and Cross-layer outline [15].

Cross-layer is changing into a principal focusing on area for remote exchanges. Also, the routine layered approach displays three central issues:

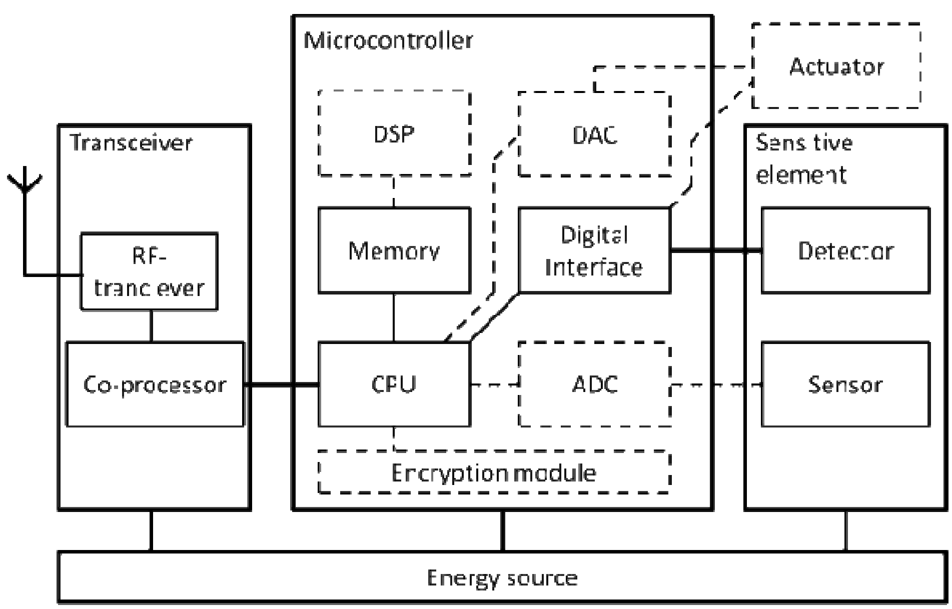

Figure 1 - Architecture of WSN Node

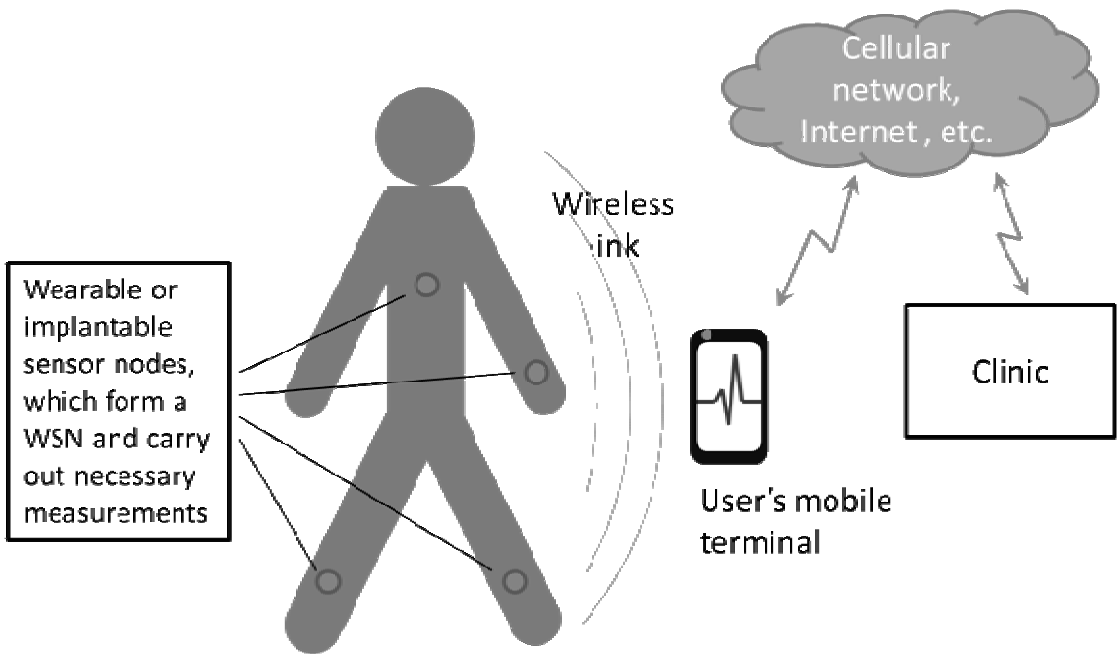

Figure 2 - Applications of WSN in Medical and Health Sciences

ENERGY HARVESTING TECHNIQUES

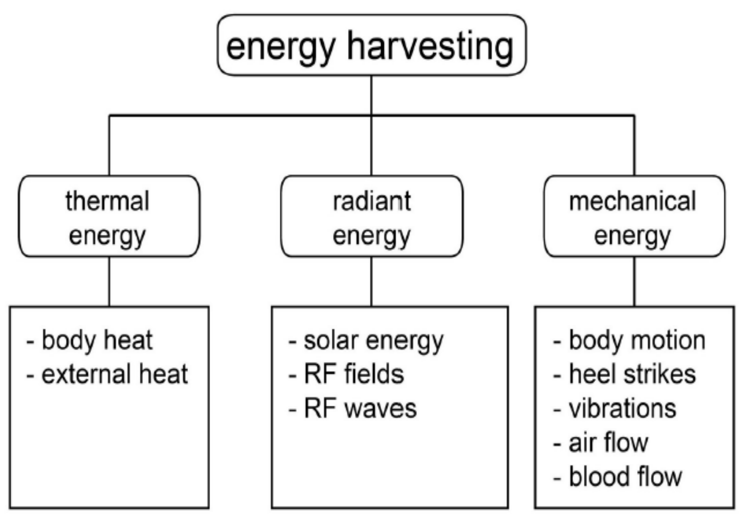

Figure 3 - Energy harvesting techniques [2]

Table 1 - Assorted Energy Harvesting Resources [14]

Energy Source	Performance (Power Density)	Notes
Solar (direct sunlight)	100 mW/cm^3	Common polycrystalline solar cells are 16 %-17 % efficient, while standard mono-crystalline cells approach 20 %
Solar (illuminated office)	100 $\mu W/cm^3$	
Thermoelectric	$^{a)}60\mu W/cm^2$ at 5^oC gradient $^{b)}135$ $\mu W/cm^2$ at 10^oC gradient	Typical efficiency of thermoelectric generators are $\leq 1\%$ for $\Delta T<40^oC$ $^{a)}$Seiko Thermic wristwatch at 5^oC body heat, $^{b)}$Quoted for a Thermo Life generator at $\Delta T = 10\ ^oC$
Blood Pressure	0.93W at 100mmHg	When coupled with piezoelectric generators, the power that can be generated is order of μW when loaded continuously and mW when loaded intermittently
Proposed Ambient airflow Harvester	177 $\mu W/cm^3$	Typical average wind speed of 3 m/s in the ambient.
Vibrational Micro-Generators	4 $\mu W/cm^3$ (human motion-Hz) $800\mu W/cm^3$ (machines-kHz)	Predictions for 1 cm^3 generators. Highly dependent on excitation (power tends to be proportional to ω, the driving frequency and y_o, the input displacement
Piezoelectric Push Buttons	50 $\mu J/N$	Quoted at 3 V DC for the MIT Media Lab Device

REVIEW OF LITERATURE

To propose and defend the research work, a number of research papers are analyzed. Following are the excerpts from the different research work performed by number of academicians and researchers.

Zhang, R., Thiran, P., & Vetterli, M. (2015) [3] – This paper presents that the energy efficiency of wireless sensor networks (WSNs) can be improved by moving base stations (BSs), as this scheme evenly distributes the communication load in the network. However, physically moving

BSs is complicated and costly. In this paper, the authors propose a new scheme: virtually moving the BSs. This work deploys an excessive number of BSs and adaptively re-select a subset of active BSs so as to emulate the physical movement. Beyond achieving high energy-efficiency, this scheme obviates the difficulties associated with physically moving the BSs. The challenges are (i) that the energy efficiency of BSs should be considered as well, in addition to that of the sensor nodes and (ii) that the number of candidate subset of active BSs is exponential with the number of BSs. This paper show that scheduling the virtual movement of BSs is NP-hard. Then, this work propose a polynomial-time algorithm that is guaranteed under mild conditions to achieve a lifetime longer than 62% of the optimal one. In practice, as verified through extensive numerical simulations, the lifetime achieved by the proposed algorithm is always very close to the optimum.

Amiri, E., Keshavarz, H., Alizadeh, M., Zamani, M., & Khodadadi, T. (2014) [4] - In this paper, the authors propose an optimal routing protocol for WSN inspired by the foraging behavior of ants. The ants try to find existing paths between the source and base station. Furthermore, we have combined this behavior of ants with fuzzy logic in order for the ants to make the best decision. In other words, the fuzzy logic is applied to make the use of these paths optimal. Our algorithm uses the principles of the fuzzy ant colony optimization routing (FACOR) to develop a suitable problem solution. The simulation results show that the proposed algorithm optimizes the energy consumption amount, decreases the number of routing request packets, and increases the network lifetime in comparison with the original AODV.

Aslam (2011) [5] - Bunching strategies have developed as a prevalent decision for attaining to vitality productivity and adaptable execution in expansive scale sensor systems. Bunch arrangement is a procedure whereby sensor hubs choose which group head they ought to take up with among different decisions. Our procedure is equipped for utilizing numerous individual measurements as a part of the group head choice process as information while at the same time enhancing on the vitality proficiency of the individual sensor hubs and also the general framework. The proposed procedure is actualized as a conveyed convention in which every hub settles on its choice taking into account nearby data just.

Adeel A. (2010) [6] - This paper clarifies about the three models in wireless sensor systems, which are as per the multiple models In the model system is assembled into diverse bunches. Every group is made out of one bunch head (CH) and bunch part hubs. The separate CH gets the sensed information from bunch part hubs, totals the sensed data and after that sends it to the Base Station. In this the creator told about the versatile intra bunching steering. In this the creator told that one of the significant limitations of WSN is vitality. In this examination work this issue is remembered and an answer for restricted vitality source has been proposed. The proposed arrangement is "Vitality Aware Intra Cluster Routing". In this calculation while keeping the degree to intra bunch correspondence every hub is not indistinguishable to other for directing the information. A few hubs are considered in close locale and they perform direct steering and outside the district hubs receive multihop directing. Along these lines the closer hubs are not having additional load on them.

Dondi (2008) [7] - In this paper, the creators propose a technique for upgrading a sun oriented gatherer with greatest force point following for self-controlled wireless sensor system (WSN) hubs. This work concentrate on amplifying the collector's effectiveness in exchanging vitality from the sun based board to the vitality putting away gadget. A photovoltaic board systematic model, taking into account a streamlined parameter extraction method, is received. This model predicts the prompt force gathered by the board helping the gatherer outline and advancement technique. Also, a point by point displaying of the reaper is proposed to comprehend fundamental collector conduct and enhance the circuit. Test results taking into account the exhibited outline rules exhibit the adequacy of the embraced procedure. This outline system helps in boosting productivity, permitting to achieve a most extreme effectiveness of 85% with discrete segments. The application field of this circuit is not restricted to self-fueled WSN hubs; it can undoubtedly be stretched out in installed compact applications to augment the battery life.

Ammer (2006) [8] - To wind up really pervasive, sensor system hubs must attain to ultra low power utilization. This paper proposes the vitality every valuable bit (EPUB) metric for assessing and contrasting sensor system physical layers. EPUB incorporates the vitality utilization of both the transmitter and beneficiary, and amortizes the vitality utilization amid the synchronization prelude over the quantity of information bits in the parcel. Utilizing EPUB, we analyze six current sensor system PHYs. Next, we improve the PHY as indicated by EPUB. We presume that the EPUB of sensor system PHYs can be lessened by expanding information rate, bringing down bearer recurrence, and utilizing basic adjustment plans, for example, OOK to decrease synchronization overhead

Sankarasubramaniam (2003) [9] - This paper addresses the topic of ideal parcel size for information correspondence in vitality obliged wireless sensor systems. Dissimilar to past chip away at bundle length enhancement in other wired and wireless systems, vitality effectiveness is picked as the streamlining metric.

EXISTING APPROACH

The existing or classical approach titled single cluster head and base station based technique is not appropriate for handling the multiple nodes with higher efficiency.

PROPOSED WORK AND METHODOLOGY

In the proposed research work and algorithm titled activation base station oriented approach, the advent of multiple and assorted locations base stations are implemented and the results show that the Euclidean Distance [10, 11] based identification and transfer of the data to nearest base station is giving better and effective results as compared to the classical approach. The activation and sleep mode [12, 13] the nodes are applied to each base station depending upon the requirement of the signals. The Algorithmic Approach keeps track of the movement of the sensor nodes regarding energy transfer and conservation. The energy level of each wireless node (mote) is regularly detected by the simulator / testbed. The implementation of multiple base stations in

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the matrix formation is done for energy optimization. Multiple base stations as activation matrix are keeping the energy very optimal if nodes send data / signal to the nearest base station.

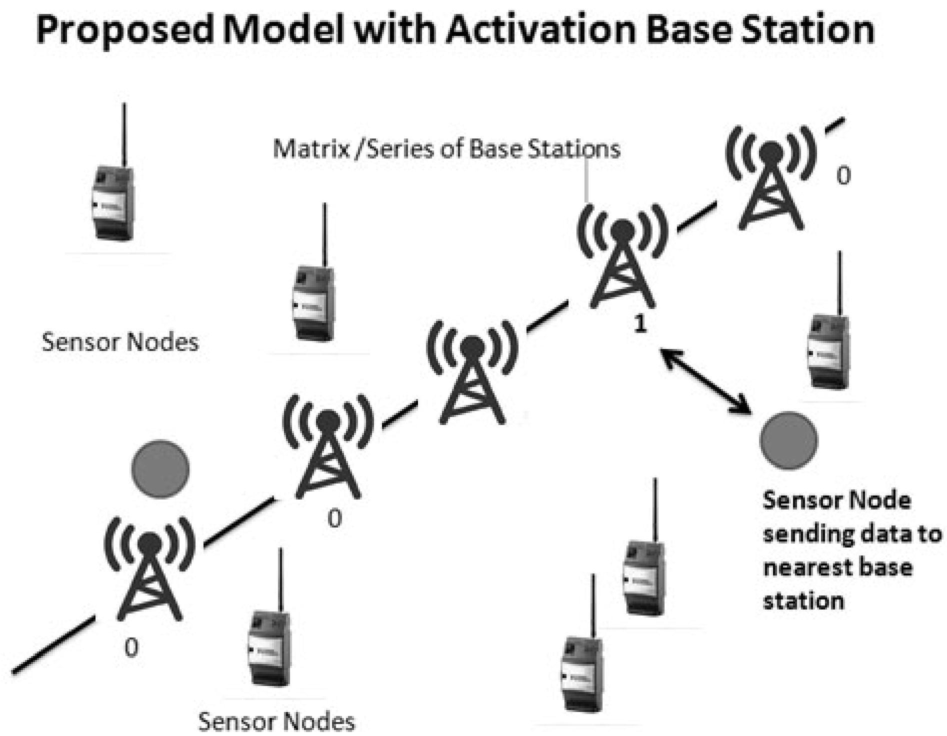

Figure 4 - System Model of the Proposed Approach

PLATFORM AND TOOLS USED FOR IMPLEMENTATION

1. ns2
2. xgraph
3. gnuplot
4. Red Hat Linux
5. sed
6. awk

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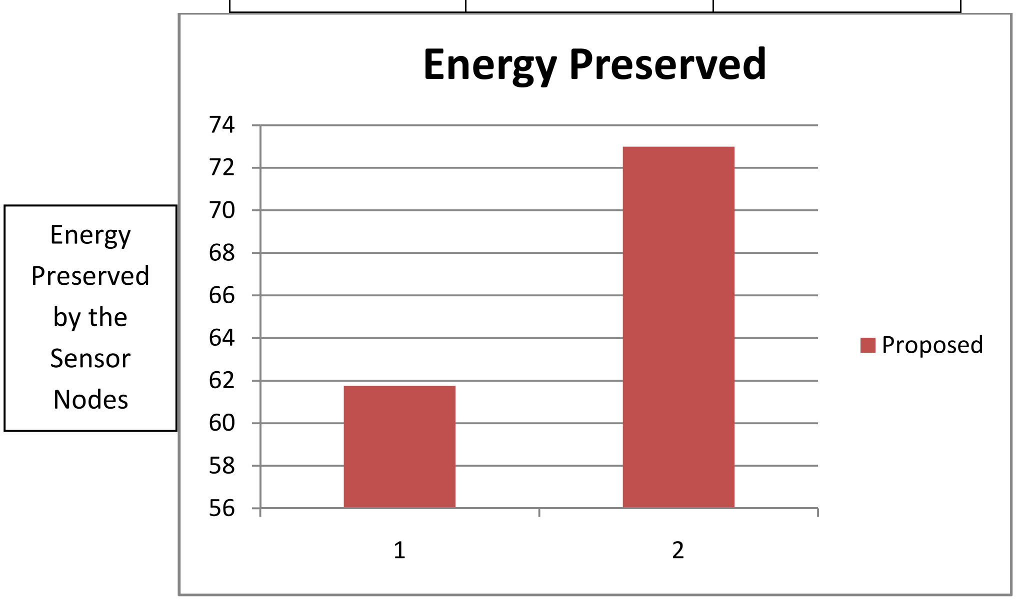
RESULTS AND DISCUSSION

In the following results, it is shown the difference between the classical and proposed approach in terms of the energy preserved that is the key point in our research work. As we have mentioned and proposed in the research objectives that the dying time or overall energy of the proposed algorithm will be maintained, the following results depicts the major difference between the classical and proposed approach. Additionally, it is clear that the implementation scenarios are generating the output so that the energy preservation is more as compared to the classical approach.

Energy Preserved / Optimized in Cumulative Approach		
Nodes	**Implementation Scenario 1**	**Implementation Scenario 2**
Proposed	64	72.4



Simulation Attempt 1 **Simulation Attempt 2**

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Figure 5 – Performance of Existing and Proposed Simulation

Figure depicts the overall performance of the simulation in terms of energy conservation. The proposed work is giving better results as compared to the classical approach.

Comparison of Cumulative Execution Time	
Proposed	3.5
Existing	4.8

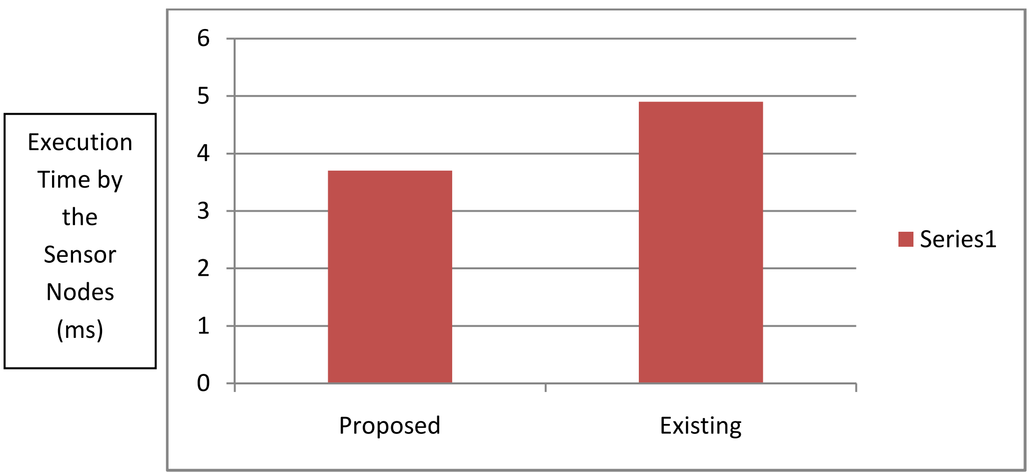

Figure 6 – Execution Time of Existing and Proposed Simulation

It is evident from the abovementioned bar graph that the proposed approach is better in terms of the execution time as compared with the classical approach.

CONCLUSION AND SCOPE OF FUTURE WORK

Power advancement is a standout amongst the most touched zone in the area of wireless sensor systems can successfully act in numerous applications. Cross-layer is turning into an imperative considering territory for wireless interchanges. What's more, the conventional layered methodology brings three fundamental issues to us. (1) Traditional layered methodology can't impart distinctive data among diverse layers, which prompts each one layer not having complete data. The conventional layered methodology can't promise the advancement of the whole system. (2) The customary layered methodology does not can adjust to the ecological change. (3) Because of the impedance between the diverse clients, access confliction, blurring, and the change of environment in the wireless sensor systems, conventional layered methodology for wired systems is not material to wireless systems. So we can utilize cross-layer to make the ideal tweak to enhance the transmission execution, for example, information rate, vitality effectiveness, QoS (Quality of Service), and so forth. Sensor hubs can be envisioned as little PCs, to a great degree essential as far as their interfaces and their segments. They typically comprise of a transforming unit with restricted computational power and constrained memory, sensors or MEMS (counting particular molding hardware), a specialized gadget (normally radio handsets or then again optical), and a force source for the most part as a battery.

For future scope of the work, following techniques can be used in hybrid approach to better and efficient results –

- Ant Colony Optimization
- Artificial Neural Networks
- HoneyBee Algorithm
- Simulated Annealing
- Genetic Algorithmic Approaches

REFERENCES

[1] Werner-Allen, G., Lorincz, K., Ruiz, M., Marcillo, O., Johnson, J., Lees, J., & Welsh, M. (2006). Deploying a wireless sensor network on an active volcano.*Internet Computing, IEEE*, *10*(2), 18-25.

[2] Schurgers, C., & Srivastava, M. B. (2001). Energy efficient routing in wireless sensor networks. In *Military Communications Conference, 2001. MILCOM 2001.*

Communications for Network-Centric Operations: Creating the Information Force. IEEE (Vol. 1, pp. 357-361). IEEE.

[3] Zhang, R., Thiran, P., & Vetterli, M. (2015). Virtually Moving Base Stations for Energy Efficiency in Wireless Sensor Networks. In *The Sixteenth ACM International Symposium on Mobile Ad Hoc Networking and Computing*.

[4] Amiri, E., Keshavarz, H., Alizadeh, M., Zamani, M., & Khodadadi, T. (2014). Energy efficient routing in wireless sensor networks based on fuzzy ant colony optimization. *International Journal of Distributed Sensor Networks*, *2014*.

[5] Aslam, N., Phillips, W., Robertson, W., & Sivakumar, S. (2011). A multi-criterion optimization technique for energy efficient cluster formation in wireless sensor networks. *Information Fusion*, *12*(3), 202-212.

[6] Akhtar, A., Minhas, A. A., & Jabbar, S. (2010). Energy aware intra cluster routing for wireless sensor networks. *International Journal of Hybrid Information Technology*, *3*(1).

[7] Dondi, D., Bertacchini, A., Brunelli, D., Larcher, L., & Benini, L. (2008). Modeling and optimization of a solar energy harvester system for self-powered wireless sensor networks. *Industrial Electronics, IEEE Transactions on*, *55*(7), 2759-2766.

[8] Ammer, J., & Rabaey, J. M. (2006, September). The energy-per-useful-bit metric for evaluating and optimizing sensor network physical layers. In *Sensor and Ad Hoc Communications and Networks, 2006. SECON'06. 2006 3rd Annual IEEE Communications Society on* (Vol. 2, pp. 695-700). IEEE.

[9] Sankarasubramaniam, Y., & McLaughlin, S. W. (2003). Energy efficiency based packet size optimization in wireless sensor networks. In *Sensor Network Protocols and Applications, 2003. Proceedings of the First IEEE. 2003 IEEE International Workshop on* (pp. 1-8). IEEE.

[10] Danielsson, P. E. (1980). Euclidean distance mapping. *Computer Graphics and image processing*, *14*(3), 227-248.

[11] Wittneben, A. (1991, May). Basestation modulation diversity for digital SIMULCAST. In *Vehicular Technology Conference, 1991. Gateway to the Future Technology in Motion., 41st IEEE* (pp. 848-853). IEEE.

[12] Shah, T., Javaid, N., & Qureshi, T. N. (2012, December). Energy efficient sleep awake aware (eesaa) intelligent sensor network routing protocol. In *Multitopic Conference (INMIC), 2012 15th International* (pp. 317-322). IEEE.

[13] Olariu, S., & Xu, Q. (2005, April). Information assurance in wireless sensor networks. In *Parallel and Distributed Processing Symposium, 2005. Proceedings. 19th IEEE International* (pp. 5-pp). IEEE.

[14] Alippi, C., & Galperti, C. (2008). An adaptive system for optimal solar energy harvesting in wireless sensor network nodes. *Circuits and Systems I: Regular Papers, IEEE Transactions on*, *55*(6), 1742-1750.

[15] Dargie, W. and Poellabauer, C., "Fundamentals of wireless sensor networks: theory and practice", John Wiley and Sons, 2010 ISBN 978-0-470-99765-9, pp. 168–183, 191–192