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Study And Performance Analysis Of Energy Utilization In Teen-Protocol

G. Sahitya
A Seema Sulthana
G. Vinay Kumar
L.Dheeraj Kumar
Department Of ECE
VNRVJIET
Hyderabad, India

Abstract—
In the near future, wireless sensor networks are poised to witness widespread application and increased adoption. This research paper introduces an original classification of sensor networks based on their operational characteristics, distinguishing them as proactive or reactive networks. Reactive networks promptly respond to changes in relevant parameters, while proactive networks passively collect data without immediate reaction. A dedicated routing protocol, TEEN (Threshold-sensitive Energy Efficient sensor Network protocol), has been developed specifically for Wireless Sensor Networks (WSNs). TEEN aims to enhance the overall effectiveness of WSNs by optimizing energy usage. TEEN employs a threshold-sensitive mechanism to filter incoming data and selectively transmit pertinent information to the base station. By utilizing different criteria for various data types, the protocol minimizes the transmission of redundant and unnecessary data, resulting in significant energy savings and prolonged lifespan for the sensor nodes. To achieve energy efficiency, TEEN incorporates strategies such as data aggregation, in-network processing, and sleep schedules. The protocol has shown promising outcomes in extending the longevity and improving the efficiency of WSNs, all while upholding a high level of security.

Keywords*—Teen(Threshold Sensitive Energy Efficient Sensor Network Protocol) , Bs (Base Station) , Ch (Cluster Head) , Wsn (Wireless Sensor Network).*

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I. INTRODUCTION

REQUIREMENTS OF SENSOR NETWORKS

In recent years, wired sensor networks have gained significant recognition and support due to their diverse range of applications. One prominent example involves the deployment of numerous sensors and wiring in critical areas of structures, such as airplanes, enabling continuous monitoring of conditions both internally and externally. This setup allows for timely detection of potential failures, triggering immediate warnings.

Given that sensor networks are often unattended, it is crucial for them to exhibit fault tolerance to minimize maintenance needs. This attribute becomes especially important when sensors are located in challenging environments, as buildings or rugged terrains with limited accessibility, the deployment of wireless sensor networks becomes crucial for various services. Recent technological advancements have enabled the development of highly compact, low-power devices with programmable computing capabilities, extensive parameter sensing, and wireless communication functionalities.

These advancements have significantly reduced the cost of sensors, making it feasible to create large-scale networks comprising hundreds or even thousands of wireless sensors. This not only improves data accuracy and reliability but also enhances the coverage over a broader area. Moreover, it is essential for these sensors to be easily installed, ensuring convenience and efficiency.

Given the limited capacity of the sensor nodes, it is necessary to design protocols that effectively utilize their capabilities. Furthermore, the environments in which these nodes operate are characterized by high dynamism and rapidly changing physical parameters. Depending on the specific application, several parameters may dynamically alter, including Power accessibility.

- The position (if the nodes are mobile).
- Capacity to be reached.

- Task type (i.e., the properties that nodes must act on)

Because of this, the routing protocol in such a dynamic setting should be fault-tolerant. The following are some reasons why conventional routing algorithms are inadequate for wireless ad hoc networks:

1. Sensor networks are "data-centric," meaning that data is requested based on specified properties, such as which area has a temperature above 50°F, in contrast to traditional networks, where the data is sought from a specific node.
2. It is application-specific since the network requirements alter depending on the application [3]. For instance, some applications require data based solely on one feature, while others require data from fixed sensor nodes that are not mobile (i.e., the attribute is fixed in this network).
3. There may be similar data on nearby nodes. Thus, it is preferable to aggregate similar data and transfer it rather than delivering data from each node separately to the requesting node.
4. Each node in conventional wired and wireless networks is assigned a distinct id that is used for routing. The usage of this in sensor networks is ineffective.

This is because routing to and from particular nodes is not necessary for these networks because they are data-centric.

Moreover, in large-scale sensor networks, the significant number of nodes contributes to the generation of large IDs [2]. These IDs can be much larger than the actual data being transmitted. Consequently, it becomes imperative to employ application-specific, data-centric protocols that can efficiently aggregate data and manage energy consumption in sensor networks.

In an ideal sensor network, several additional characteristics should be incorporated. Attribute-based addressing is commonly used, where attribute-value pairs are employed to indicate the physical parameters being sensed. For example, an attribute address could be expressed as (temperature > 100F, location = ??). In this case, any node detecting a temperature exceeding 100F must respond along with its location information.

Location awareness is another critical aspect that should be considered. Nodes within the network should possess constant knowledge of their respective locations as location-based data collection becomes a standard requirement. By maintaining location awareness, the network can effectively facilitate data gathering based on spatial information.

II. Related work

Classification of Routing Protocols:

A routing protocol defines the communication paths used by routers to exchange information and identify the optimal route between any two network nodes. Routing algorithms are employed to determine a specific path. Wireless Sensor Networks (WSNs) can exhibit various topologies, ranging from simple star networks to complex multi-hop wireless mesh networks. However, due to the unique constraints imposed on sensor nodes and the distinctive characteristics of WSNs that differentiate them from conventional communication and wireless ad hoc networks, the successful routing of data among nodes becomes critically important yet challenging.

Routing protocols can be classified into two categories: proactive and reactive, based on how the source determines the path to the destination. Proactive protocols establish routing paths and states even before there is a need for routing traffic. These paths are maintained even when there is no traffic being transmitted. On the other hand, reactive routing protocols come into action when data needs to be delivered and distributed to other nodes. They initiate routing actions specifically when queries are launched, and pathways are set up accordingly.

In proactive processes, all routes are calculated in advance, even before they are actually needed. Routes are only computed in reactive protocols when they are required.

III. Multi-Level Hierarchical Clustering:

Currently, our research focuses on developing a model that can be effectively utilized across different sensor networks, drawing inspiration from the Yanhong et al. model [4]. This model presents a framework where end users can access sensor network data through a dedicated base station (BS), separate from the individual nodes. Homogeneity is maintained among all nodes in the network, as they start with the same initial energy levels.

In contrast to the nodes, the base station (BS) benefits from a continuous power supply, eliminating energy constraints. Consequently, high-power broadcasts can be received by all nodes within the network. As a result, there is no need for specific routing from the BS to individual nodes. However, due to limited power resources, the nodes have restricted capacity to directly respond to the BS, leading to asymmetric communication patterns.

Within the network, each cluster is assigned a cluster head responsible for gathering data from the member nodes within the cluster. The cluster head then aggregates the collected data and transmits it either to the base station or to an upper-level cluster head, depending on the network's hierarchy or configuration. This hierarchical structure allows for efficient data consolidation and transmission within the sensor network.

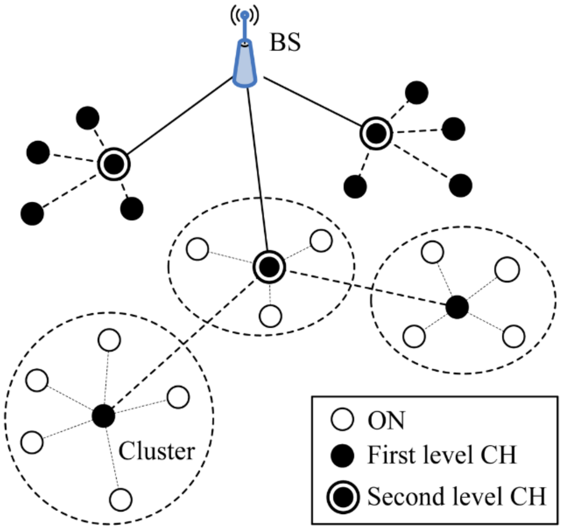

Fig 1: Hierarchical Clustering

This hierarchy's central node, the BS, governs the whole network. The major characteristics of such an architecture are:

1. All nodes only need to communicate to the cluster head that is immediately adjacent to them, conserving energy.
2. The only person who needs to execute further computations on the data is the cluster leader. Energy is thus once more preserved.

A disadvantage of CHs is that they use energy more quickly than other nodes due to the additional computations they carry out.
Solution: Cluster time. All nodes alternately take on the role of the cluster head for the duration T, also known as the cluster period, in order to distribute CHs consumption evenly.

IV. LEACH

The value for the sensed property is periodically transmitted by the sensors in proactive networks. Sensors and transmitters are sometimes turned off to conserve energy. The applications that need a routine inspection, such as monitoring gear for fault detection and diagnostics, are best suited for this type of network. A network protocol that is proactive can be approximated well by LEACH (Low Energy Adaptive Clustering Hierarchy).

Increasing the transmission intervals in a wireless sensor network leads to a reduction in overall transmissions, resulting in energy savings for the sensors. However, this longer timeframe poses a challenge for time-sensitive applications as real-time data may not reach the user in a timely manner. On the other hand, decreasing the interval ensures that vital information reaches the user with minimal delay. However, this approach shortens the network's lifespan due to increased data transmissions and energy consumption.

In terms of proactive network protocols, LEACH is a closely approximated example with a few minor exceptions. After the formation of clusters, the Cluster Heads (CHs) broadcast a Time Division Multiple Access (TDMA) schedule, indicating the order in which cluster members can transmit data. While users cannot control the TDMA schedule, it determines the frame time and is not broadcast by the CH. Additionally, the properties of the network are fixed and cannot be altered once initially installed.

This network configuration is well-suited for equipment monitoring to diagnose and address faults, as well as collecting information on temperature, pressure, or moisture patterns within a specific area. However, data collection is centralized and conducted periodically, making it most suitable for ongoing network monitoring.

Since users typically do not require all of the data at all times, recurring data transmissions become unnecessary, leading to increased energy consumption for each sensor.

V. Proposed Work

TEEN (Threshold-sensitive Energy Efficient sensor Network protocol) is an exemplary reactive network protocol. Within reactive networks, sensor nodes promptly transmit the measured value once a specific parameter surpasses a threshold value set by the user. This attribute makes TEEN particularly well-suited for applications that necessitate swift access to time-sensitive data. The TEEN (Threshold-sensitive Energy Efficient sensor

Network) protocol was developed for these networks. If the thresholds are not passed, the network is insufficient for applications that require periodic data from the network because the user cannot know the state of the network at that time. The CH broadcasts the following using this system message to its members at each cluster change time in addition to the attributes. TEEN Functioning:

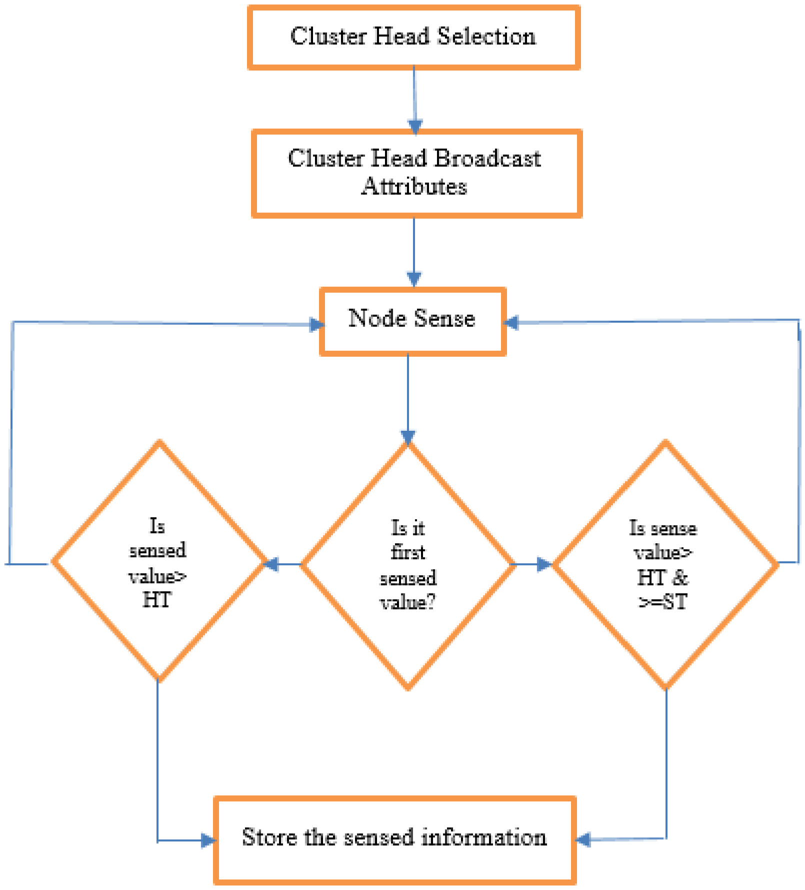

Fig 2: Flowchart of functioning of the TEEN protocol

Hard threshold (HT): This is a threshold setting designed for reactive networks for detected properties. Beyond which the node sensing this value must turn on its transmitter and communicate to its CH, this value is the absolute value of the characteristics.

Soft threshold (ST): This is a slight variation in the sensed attributes' values that causes the node to turn on its transmitter and start transmitting.

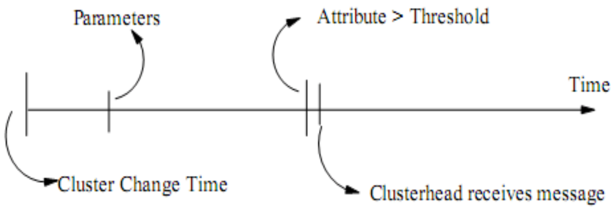

Fig 3: Timeline of TEEN

The nodes continuously sense their surroundings. The node turns on its transmitter and communicates the sensed data when a parameter from the attribute set first hits the hard threshold value. Moreover, the sensed value is kept in a node internal variable called SV. Only when both of the following requirements are met will the nodes send their subsequent data transmission during the current cluster period.

1. The sensed attribute's current value is higher than HT.
2. The difference between the current value of the detected characteristic and the SV is higher than the ST.

By way of restricting the nodes' capability to speak until the sensed characteristic is within the variety of hobbies, the HT ambitions to reduce the number of transmissions. The ST similarly reduces the number of transmissions by casting off all the transmissions that might have taken place whilst the sensed attribute modified little to never after the HT. nonetheless, this set of rules number one flaw is that if the thresholds aren't met, the nodes will no longer have interaction, the consumer will no longer get hold of any facts from the network, and even if the nodes die, no one can be knowledgeable. As a result, this technique is irrelevant for packages wherein obtaining information on a common foundation is needed. This gadget has the advantage of being ideally suited for time-sensitive data-sensing packages. because facts transmission makes use of more electricity than facts sensing and happens much less often in this method, strength usage may be considerably decreased than in proactive networks.

Clussub-nodes $\sqrt{(\mathbf{1.262} * \mathbf{num\_nodes}) \div \mathbf{2}\boldsymbol{\Pi}}$

- Energy consumption of TEEN:

E_i = E_i - (E_tx * d_i^2)

- E_elec is the energy dissipated by the transmitter or receiver circuitry
- L is the packet size
- d is the distance between the transmitter and the receiver
- d0 is a threshold distance beyond which a different path loss exponent is used epsilon_fs and epsilon_mp are the path loss coefficients for free space and multi-path environments, respectively.

VI. SIMULATION

To optimize energy consumption and maximize sensor efficiency, a cluster protocol called LEACH (Low-Energy Adaptive Clustering Hierarchy) was introduced. LEACH divides all sensors into clusters and selects a cluster head based on factors such as energy level or proximity to the base station. The cluster head, being free from energy constraints, acts as a central node within the cluster. Other sensors within the cluster can transmit their data to the nearest cluster head, which then communicates with the base station, consolidating and reporting the information. This hierarchical approach allows for efficient data aggregation and transmission within the sensor network.

The sensor just has to ship statistics to the closest cluster head so its strength can be saved however sending data every c program language period may eat extra strength as sense facts do always no longer change at extraordinary intervals. So to store and correctly use sensor electricity cluster protocol changed into brought referred to as LEACH (low electricity adaptive clustering hierarchy) which divides all sensors into clusters and then elects one node that has a cluster head that has the most electricity or is nearest to the base station. The cluster Head will no longer have power constraints so all sensors may additionally feel information and record it to the nearest cluster head after which it'll report to the base station.

The sensor just has to send statistics to the closest cluster head so its energy may be saved but sending records in each c language may additionally devour greater strength as feel facts does constantly no longer trade at distinctive durations. So in the proposed paper author introduces TEEN protocol (Threshold sensitive Energy Efficient sensor Network protocol) which consists of HARD and SOFT thresholds and if sense data > HARD threshold and in the range between soft thresholds then only data will be transmitted. So by applying this technique we can avoid redundant packet delivery and more energy can be saved

- Generate WSN Network: using this module we will generate some virtual sensors
- Hierarchical Clustering: using this module we will divide all sensors into clusters and then select one node as cluster head in every cluster group this cluster formation will be based on distance and high available energy
- Run Leach Protocol: this module simulates leach behavior which will sense random data every second and report all packets to the cluster head and for each transmission, we will record transmission energy and residual energy
- Run Teen Protocol: using this module we will sense random data and if this data > Hard threshold and in the range between soft threshold then only the packet will be sent to the cluster head otherwise the packet will be ignored
- Energy Dissipated Graph: using this module we will plot dissipation energy between leach and TEEN and leach will send a packet every interval so it dissipates or lose more energy
- Energy Residual Graph: using this module we will plot the available energy graph between leach and propose TEEN. So TEEN will send packets based on threshold satisfaction so it saves more energy

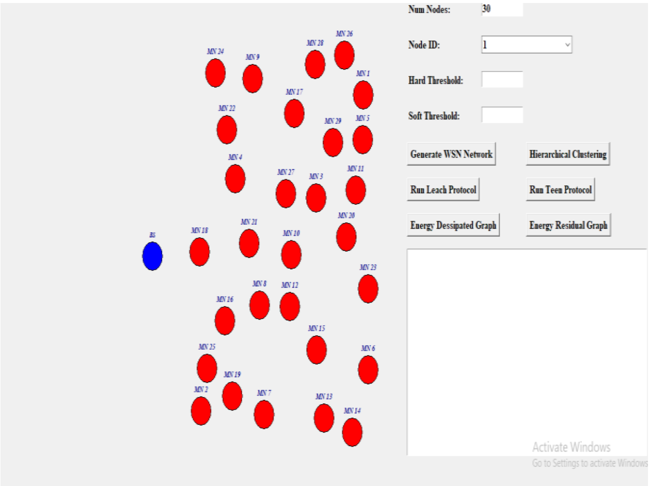

Fig 4 : In the above picture, we entered 30 as a number of nodes and then clicked on the 'Generate WSN Network' button to display 30 sensors where the blue color node is the Base Station and the Red color nodes are the normal sensors and clicked on 'Hierarchical Clustering' button to divide all sensors into the cluster and get the above output.

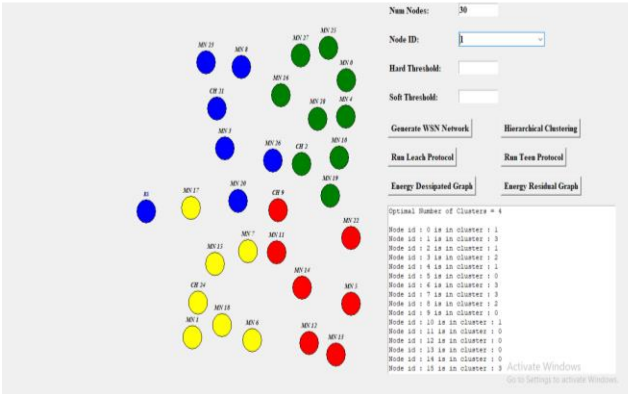

Fig 5: In the above screen different color nodes represent different Cluster and for each cluster, you can find one node with the label as CH now select any source sensor from the Node ID drop-down box and then enter the hard and soft threshold.

Fig 6:In the above screen, I selected the source sensor as 8 and then entered the Hard threshold as 20 and soft as 40 and now click on 'Run Teen Protocol'. sending packet using Teen Protocol you can see a black line will appear less number of times compared to leach while sending data as it always checks the threshold before sending data. Similarly, send a packet by selecting different sources for few times and then click on graph buttons to get the below graph.

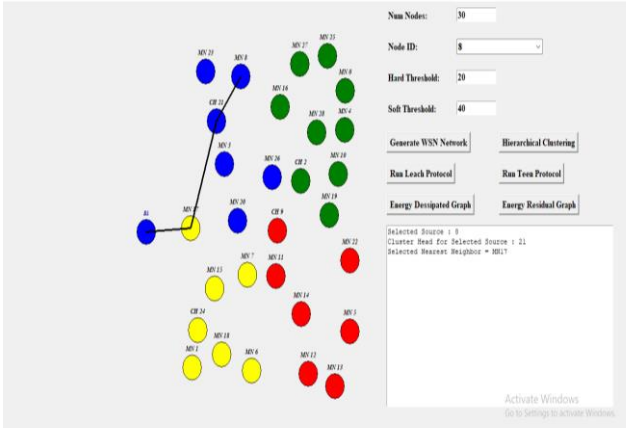

Fig 7: Leach protocol

Energy Graphs

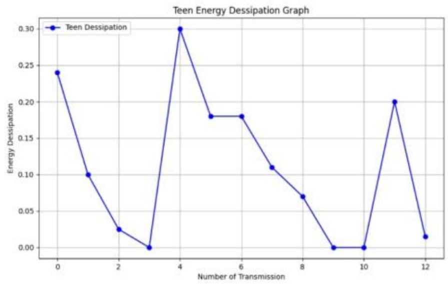

Fig 8: In the above energy dissipation graph x-axis represents the number of transmissions and the y-axis represents the energy dissipation

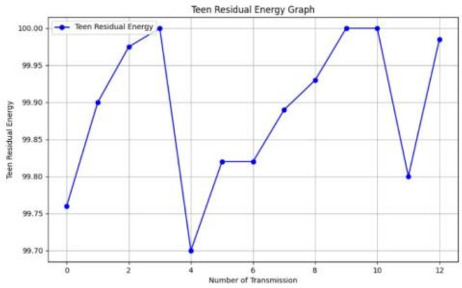

Fig 9:In the above energy dissipation graph x-axis represents Teen Residual Energy and the y-axis Number of Transmissions.

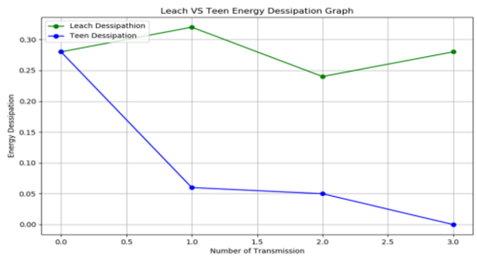

Fig 10: In above energy dissipation graph x-axis represents number of transmission and y-axis represents energy dissipation and blue line represents TEEN energy dissipation and green line represents Leach energy dissipation. In above graph we can see leach loose more energy

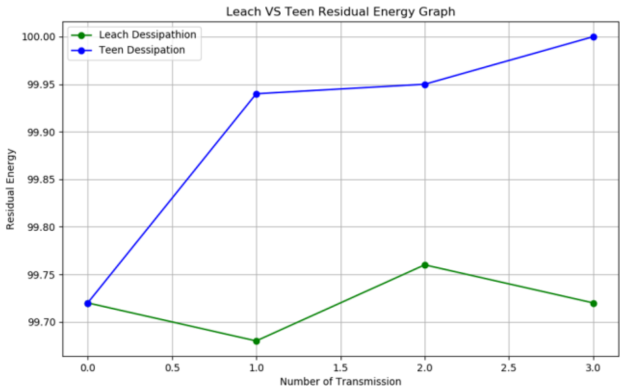

Fig 11: In the above residual energy graph blue line represents Teen's available energy as it sends only threshold satisfaction packets so it saves more energy and Leach sends all packets so it saves less energy

VII.CONCLUSION

In this paper, we provide a comprehensive classification of sensor networks. Furthermore, we introduce the TEEN network protocol specifically designed for reactive networks. The TEEN protocol exhibits notable advantages in terms of energy consumption, response time, and is particularly well-suited for time-sensitive applications. One of the key features of TEEN is its flexibility, allowing users to adjust the accuracy and energy usage according to the specific requirements of their applications.

REFERENCE

[1]. J. Broch, D. Maltz, D. Johnson, Y. Hu, And J. Jetcheva. "A Performance Comparison Of Multi-Hop Wireless Ad Hoc Network Routing Protocols". In Proceedings Of The Fourth Annual Acm/Ieee International Conference On Mobile Computing And Networking(Mobicom), Acm, October 1998.

[2]. J. Elson And D. Estrin. "An Address-Free Architecture For Dynamic Sensor Networks". Technical Report 00-724, Computer Science Department, Usc, January 2000.

[3]. D. Estrin, R. Govindan, J. Heidemann, And S. Kumar. "Next Century Challenges: Scalable Coordination In Wireless Networks". In Proceedings Of The 5th Annual Acm/Ieee International Conference On Mobile Computing And Networking(Mobicom), Pages 263–270, 1999.

[4]. W. Heinzelman, A. Chandrakasan, And H. Balakrishnan. "Uamps Ns Code Extensions". Http://Wwwmtl.Mit.Edu/Research/Icsystems/Uamps/ Leach.

[5]. W. Heinzelman, A. Chandrakasan, And H. Balakrishnan. "Energy-Efficient Communication Protocols For Wireless Microsensor Networks". In Proceedings Of Hawaiian International Conference On Systems Science, January 2000.

[6]. W. B. Heinzelman. "Application-Specific Protocol Architectures For Wireless Networks". Phd Thesis, Massachusetts Institute Of Technology, June 2000.

[7]. C. Intanagonwiwat, R. Govindan, And D. Estrin. "Directed Diffusion: A Scalable And Robust Communication Paradigm For Sensor Networks ". In Proceedings Of The 6th Annual Acm/Ieee International Conference On Mobile Computing And Networking(Mobicom), Pages 56–67, August 2000.

[8]. M. Jiang, J. Li, And Y. C. Tay. "Cluster Based Routing Protocol". Internet Draft, 1999.

[9]. E. M. Royer And C.-K. Toh. "A Review Of Current Routing Protocols For Ad-Hoc Mobile Wireless Networks". In Ieee Personal Communications Magazine, Pages 46–55, April 1999.[10] Ucb/Lbnl/Vint. "Network Simulator-Ns". Http://Wwwmash.Cs.Berkeley.Edu/Ns.