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Paper Authors **Vanaparthi Sharvani, Burra Abhinaya, Mashetti Saisumanth, Karnakanti Sowmya, Kanukuntla Swamy, Thakkalapalli Nikhil**

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An Energy Sustainable Forwarding Approach For Wireless Sensor Network For Energy Gathering

Vanaparthi Sharvani[1], Burra Abhinaya[2], Mashetti Saisumanth[3], Karnakanti Sowmya[4], Kanukuntla Swamy[5], Thakkalapalli Nikhil[6].

Assistant Professor, Dept. Of Electronics and Communication Engineering, Balaji Institute of Technology and Sciences, Narsampet, Warangal, Telangana.

UG Student, Dept. Of Electronics and Communication Engineering, Balaji Institute of Technology and Sciences, Narsampet, Warangal, Telangana.

Abstract

Portable, finite batteries are used to power wireless sensor networks (WSNs). The use of renewable energy in WSNs becomes essential due to a serious issue and the expanding demand in sensor networks for multimedia applications.The development and implementation of the energy-efficient routing protocol for energy-harvesting WSN in this study. Renewable energy is produced by solar-powered nodes in the WSN and is used for routing and sensing. When selecting routes, energy usage and energy waste are taken into account. Dynamic programming is used to calculate the shortest path and evaluate energy efficiency.

Keywords-Energy Harvesting, Wireless sensor network, Routing protocol, Energy efficiency.

I. INTRODUCTION

For the development of Internet of Things (IoT) systems, which are made up of several sensor nodes in a multi-hop self-organizing way, wireless sensor networks (WSN) are crucial. WSN has been extensively employed in a variety of industries, including the military, business, agriculture, and so on, thanks to its characteristics of simple and easy connectivity and fast data rate. A sensor node's life span is however constrained by battery's capacity because it is battery powered Energy harvesting (EH) techniques are included into the WSNs with the growth of green energy. With the use of EH methods, nodes can draw power from the surrounding environment (such as solar, wind, RF radiation, etc.) and recharge their batteries while in use, increasing the network's energy efficiency and extending its lifespan.

II RELATED WORK

Karp B-2020:

Greedy Perimeter Stateless Routing (GPSR) algorithm is a typical geographic-aware routing protocol. It consists of two types of data packet forwarding strategies,which are greedy forwarding strategy and perimeter forwarding strategy.The GPSR algorithm considers the perimeter forwarding strategy to forward the packets bypassing this area, thus ensuring the stable transmission of packets. Through a void recovery method, it solves the routing hole problem but the greedy forwarding fails.

Ding, W.; Tang, L.; Ji, S-2015:

Optimizing routing based on a congestion control (CCOR) algorithm is a congestion control algorithm. In this method, a network model is designed to detect the congestion degree of nodes. It also built a hybrid formula that considers the

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position, average packet service rate and congestion degree to determine the optimal next hop.

III. METHODOLOGY

For energy harvesting wireless sensor networks (EH-WSNs), which are dedicated to utilising the gathered energy and maximising energy efficiency, numerous routing approaches have recently been developed.The network can be considered dead if the routing algorithm fails to deliver this emergent packet. The routing algorithm should instead be created to simply optimise the flow from the soldier to the commander, independent of the energy level of unimportant nodes, as this is a better approach. This solution serves as the driving force behind our suggested routing method, which locally enhances the energy-efficiency on target nodes rather than globally balancing the network's overall energy consumpt ion.

Energy Evaluation Model:

1. Energy Harvesting Factor:

Given is the Gaussian function to model the change in EH over time.

$$EH_i(t) = a_i e^{-\frac{(t-b_i)^2}{2c_i^2}}$$

where ai, bi, ci represent the coefficients affected by light intensity.

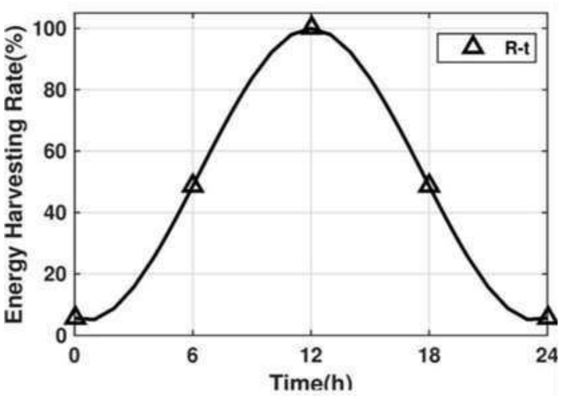

Fig-1:Energy harvesting rate in different time instant

2.Energy Consumption Factor:

Let Pt and Pr represent the relative transmission and reception powers of the nodes. The energy required to send and receive a packet can thus be stated as follows:

$$E_r^i = \min\left\{E_0^i + E_h^i - I(e(i))\left(E_{tx}^i + E_{rx}^i\right) - E_s^i, E_m\right\}$$

$$E_{tx}^i + E_{rx}^i = (P_t + P_r)\frac{L}{R}$$

In a realistic setting with interference components, Rayleigh fading channels are better suited for signal attenuation calculation models. In light of this, the received power can also be stated as follows

$$P_r = \ell P_t C d_{ij}^{-2}$$

$$C = \frac{G_t G_r \lambda^2}{(4\pi f_c)^2}$$

3.Energy Level System:

We divide the battery into three levels in order to more easily depict the leftover energy of nodes. We investigate the following two instances in relation to the remaining energy:

• Case 1 : $0 \le Er \le$ Level 1:
In this instance, the data receiving device would be briefly turned off since the node lacks the energy to sustain further data transmission. The node then checks its data buffer to see if there are any more packets left to send. If so, process the remaining packets until there is no more energy left or packets are processed; if not, turn off the sending device and put it into sleep mode.
• Case 2 : $Er \ge$ Level 2:
transmitting device and go into sleep mode. If the node is in sleep mode and the remaining energy exceeds Level 2 or the number of packets approaches 0, it will switch to active mode; if not, it will turn off the transmitting device and go

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into sleep mode.

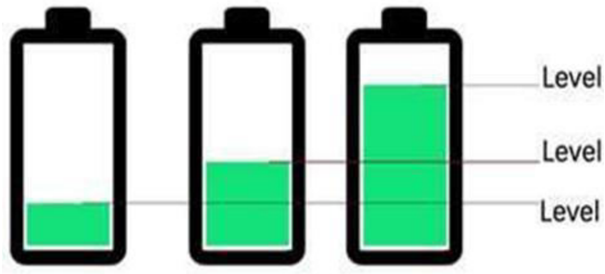

Fig-2: Energy level system

GS-EERA:

The Next Hop Selection**:**

We thoroughly examine in order to acquire a suitable relay node. The definition of the metric is:

$$M_{ij} = \alpha \hat{E}_r^j + \beta \widehat{EH}_j + \gamma\left(1 - \hat{D}_j\right) + \delta\left(1 - \hat{T}_j\right)$$

$$\begin{cases} \alpha + \beta + \gamma + \delta = 1 \\ \hat{E}_r^j = \frac{E_r^j}{E_m}; \quad \widehat{EH}_j = \frac{EH_j}{EH_{max}} \\ \hat{D}_j = \frac{D_{jd}}{D_{id}}; \quad \hat{T}_j = \frac{T_j}{\sum_{a \in CN(i)} T_a} \end{cases}$$

Where, EM and EH max, which stand for maximum values of residual energy and energy harvesting rate, respectively.

As a result, the likelihood that node i selects node j as the subsequent hop can be estimated as follows:

$$\mathbb{P}_{ij} = \frac{M_{ij}}{\sum_{j \in CN(i)} M_{ij}}$$

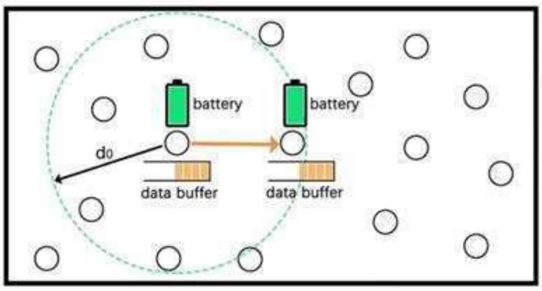

Fig-3:Reception state adjustment Mechanism

ALGORITHM

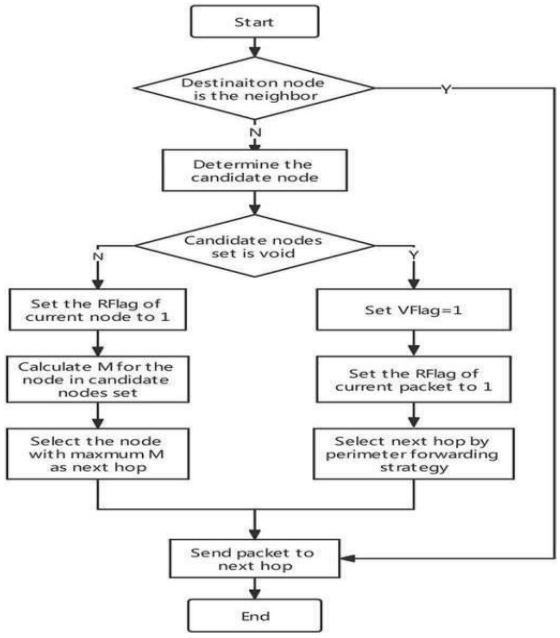

Fig-4:The procedure of GR-EESA Algorithm

VI RESULTS

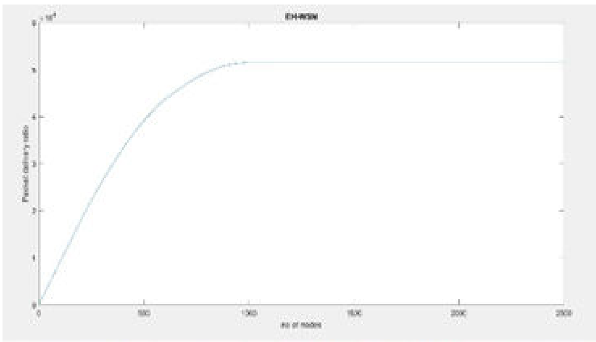

Fig-5: Graph Showing Number of nodes vs packet Devilery Ratio

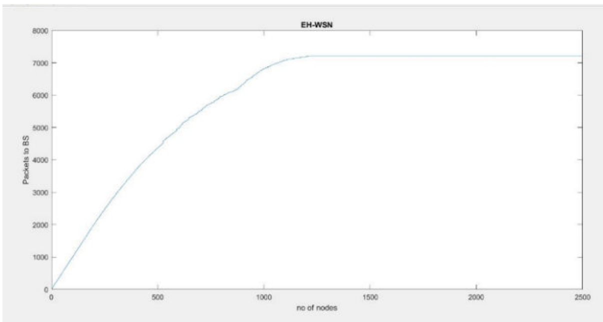

Fig-6: Graph Showing Number of nodes vs Packet Delivery Ratio

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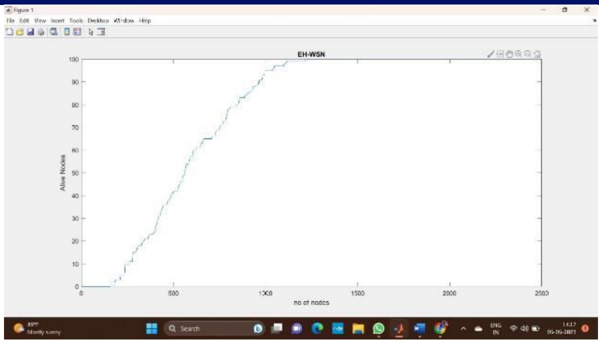

Fig-7: Number of nodes vs Energy Consumption

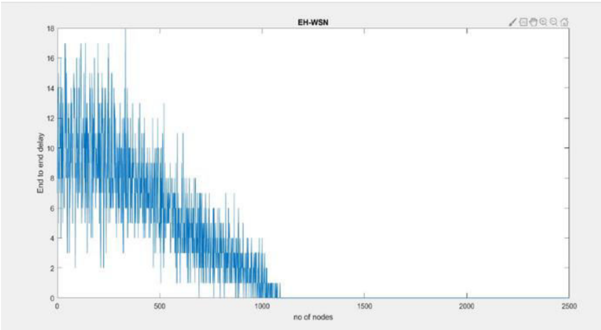

Fig-8: Number of nodes vs end to end delay

IV APPLICATIONS:

- Disaster Relief Operation
- IOTMilitary Applications
- Medical
- Environmental
- Navigation Systems
- Landslide Detection

V CONCLUSION

When compared to EHR, EHPRP, and SAGREH, this method provides the best performance in terms of average energy consumption, average end-to-end delay, packet delivery ratio, average hop count, and respectable performance in terms of energy variance.

VI FUTURE SCOPE

- Future applications for WSNs include cognitive sensing, spectrum management, security, and privacy. They can also be employed as underwater acoustic sensor systems.
- Future wireless networks will provide consistent indoor and outdoor coverage, great reliability, and communication speeds of up to 100 Gbps between users, devices, and the "Internet of Things."

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