Providing A Routing Approach With The Ability To Increase The Reliability And Lifetime Of Wireless Sensor Networks Network

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Abstract

Many wireless sensor network applications require nodes are sending the data and reduce energy consumption.In this paper, we provided a routing approach with the ability to increasing reliability and lifetime of the network routing capability.On the Basis, we provided a routing protocol packets sent to provide desired reliability and longevity of the wireless sensor networks.Proposed a multi-path approach considering the quality of the communication link to sensor nodes increase its reliability.The proposed approachuses local information of sensor nodes is scalable and can adapt to the dynamic network topology.Results show thatis also efficient in terms of energy consumption andwhile ensuring the reliability of the proposed approach increases the rate of packets sent and received packets at the destination and increases lifetime of the network.

Keywords: Routing approach, Lifetime, Reliability, Wireless sensor networks, Energy consumption.

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-6/MAGNT.03)

Introduction

In recent years, due to major advances in the design of ICs, Wireless and sensor design, a special type of wireless sensor network as wireless is the interest of the industry [1].These networks should be automatic, autonomous and non-interference, take a long time to do your homework. Wireless sensor networks, depending on the type of application, they will report to the base station or sinkinformation about the various events of the operational environment has collected and processed during the initial. Each of these events is different important applications. The networks of inherent limitations in processing power, has an energy buffer and applications is such as mobile target tracking, monitoring patient status and battlefield automated [1]. Many of these applications have different data for reporting purposes and the needs of different quality of service for each packet sent. So, given these inherent limitations, is one of the main challenges problems in wireless communications, network features and operational environment of the existence of periodic and non-periodic events, providing data routing algorithms for a variety of different needs with the ability to ensure quality of service, including reliability, of time and energy delay [2-4].Some applications of wireless sensor networks haveneeded to send the packet from source to destination. The route should be selected in such a way that it can provide the reliability required packet transmissions. On the other hand, energy is considered one of the important parameters of wireless sensor networks. In most applications and routing protocols due to the limited energy of sensor nodes, thus is important reducing power consumption and prolong the network [4-5]. This includes leaving the radio communications network energy consumption, the energy are required for sending and receiving packets of data types and energy to keep clear of the sensors. Usuallyare more, the energy consumption for sending and receiving data than others, Wireless sensor networks for environmental monitoring of its operations, there are a variety of important data. These packets are very important. This type of packet, the packet is said to be very important or essential. Provide parameters for reliability and delay sending the package because they are important, is need andnecessary. For example, Figure 1 shows how to write a report on monitoring of forests.

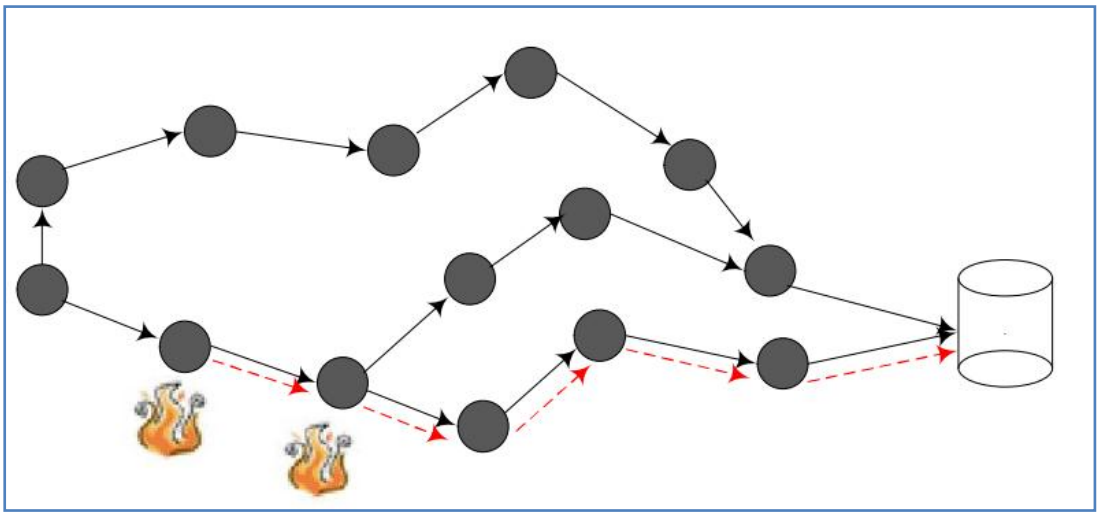

Figure 1: a real-time, and the phenomenon of forest fires

Regular events in the form of data packetshave such as a temperature of no little importance in terms of delayandsentthe normal direction to the plate. A fire to write a report on the delay of the path is

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-6/MAGNT.03)

lower than other routes. This is very important because the packets must be sent to the destination in the shortest time possible. Otherwise you will not have much importance. Thus, most of wireless sensor network applications, sent to the destination such as multimedia applications, video sensor networks and wireless body sensor networks based routing protocols need to provide improved quality of service parameters are critical to the timely and reliable data high reliability and minimal exchange of control messages. Routing protocol for wireless sensor networks for reasons major challenges faced such as high volume traffic and diversity of data, improper operating environment characteristics, the inherent resource limitations, varying quality of service demands and uncertainties of the fundamental challenges facing the wireless communication channels.

2.Related Work

Routing protocolsdivided for wireless sensor networks into two categories based on structure and topological features.Routing is based on a network structure above, the following three categories: flat, hierarchical and classified based on the location of the sensor nodes. Subsets based routing, SPIN network topology, routing protocols, such as negotiated, [7, 15] ReInForm like multi-path routing based on a query-based routing and routing based on the convergence.

Methods based on resource reservation, should not have due to the high overhead during route discovery and retrieval in large scale networks with resource constraints, the performance. Many of the proposed routing algorithms with Quality of Service parameters, used based routing table are the techniques Eelec whereeach sensor node and the neighbouring node information such as energy, delay and link quality in its routing table to save the next appropriate node based on the node parameters. Several routing protocolsare presented for wireless sensor networks [5-11]. In recent years, are considered routing based on quality of service parameters for network-aware sensorGeographic location [12-14, 15-17, 21, 24]. Because the geographic routing protocols, is scalable for large networks with variable topology and are compatible dynamic sensor networks.In this protocol, are done locally the routing decisions based on the information of neighbouring nodes and parameters. Due to the random distribution of sensor nodes in different environments in terms of environmental conditions, the geographic routing will make good use of these networks. Geographic routing, due to its impressive scalability and performance, a local routing is attractive for wireless sensor networks. Geographical routing has many advantages such as scalability, routing based on local information and adapting to dynamic network topology.

Therefore, given the constraints of wireless sensor networks and the benefits of a geographicwill be used in the proposed approach geographic routing for data transmission. Furthermore, some routing protocols for wireless sensor networkare considered the reliability and energy parameters for routing of packets will be examined. ReInForm protocol, proposed the protocol ensures packet forwarding capabilities needed to make it to the end. Given the importance of this protocol packets sent and reliability of the multiple copies of the transmitted packet is sent to a neighbouring node. The number of paths necessary is calculated to ensure the reliability of the transmitted packet, based on the transmission channel errors and network topological information (the number of steps from source to destination). This protocol does not consider the energy parameter. EQSR protocol, to select a suitable path for sending data to the sink, the sensor nodes are energy parameters, isthe ratio of signal power to noise power communication link and the buffer empty, take into consideration the next node.

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-6/MAGNT.03)

This is a multi-path protocol to increase the packet delivery to the destination uses. To specify multiple paths between source and destination, defines the route request the source node to the sink with a closed path required (RR). EARQprotocol packetssend with high reliability and in real time as well. The protocol for selecting the proper direction, energy costs also take into consideration the neighbouring nodes. For real-time packets, the node chooses to have less lag. This distinction protocol in terms of reliability and latency for packet transmission does not discriminate on the different packages they do not consider any priority. Rap protocol method uses a greedy geographic [18]. This protocol packetsisin real-time, to take into consideration depending on the speed required. The nodes selected as next node is capable of providingare closed the required speed post. Notable geographic restriction protocol RAP is a greedy, local condition such as the network load balancing, congestion level and does not consider the quality of the communication channel. Therefore, the routing protocol rap unpredictable delay for each step, the wireless sensor network is a dynamic environment and guarantee a successful and timely network performance affects the packet. Also, the disadvantages of the algorithm rap, this isnot the path, into account the energy of nodes.

SAR protocol provided one of the first protocols for wireless sensor networks is to guarantee quality of service [19]. The protocol to establish a tree structure from source to sink, the sink uses a multi-pathand to select the optimal route, delay parameters, considers load balancing and energy from the source node a neighbour. Parameters transmitted packet delay, are load balancing and energy from the source nodes neighbours. In this protocol, intermediate nodes, is sent by priority the received packet. The advantages of this protocolare broken a multi-path delay and energy taking into account factors that increase fault tolerance and rapid recovery of the links. Disadvantages of the protocol, it is not considered appropriate route selection parameters on the reliability and on the other hand, is considered the network overhead of creating and maintaining a tree structure. MCMP protocol, considered reliability and latency communication link between adjacent nodes to send packets as routing parameters and to increase reliability, the data in the form of multi-path and sends a linear programming problem [20]. The protocol, not seen it for determining routes for sending parameters of neighbouring nodes and dissemination of a pace. In this protocol packets are also sent to nodes that density and crowding. For this reason, the number of time-sensitive packets delivered to the destination, reduced because of congestion in the nodes.

DARA protocols, reliability, and latency and energy nodes as the three parameters, considers ensuring a successful real closed submission [21]. These protocols are divided packets in real-time and non-real-time packets anduses to send the packages of the same weight parameter. DARA protocol for networks with multi-well is designed multi-path and location aware network nodes. To reduce congestion and enhance network performance uses of multiple sinks in the network. In fact, instead of a multi-path, uses a path towards a single sink. For real-time packets, selects the nodes which have more residual energy. To calculate the delay, queuing theory is used to store parameters needed most.MMSpeed protocol, the protocol completion Speed and a protocol is multi-track and multi-speed [22]. The protocol for sending packets is considered to delay and reliability parameters.MMSpeed protocol flaws, this is a very important parameternot considered to select the optimal route for energy.

3.The proposed approach

A wireless sensor network as a bidirectional graph, is shownconnected and G = (V, E) where $\{v_1, v_2, \ldots, v_n\}$ is the set of nodes in sensor networks, randomly distributed in a

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uniform two-dimensional area A. E = {e_1, e_2. . .e_n} is the set of links between nodes. For two nodes v_i, v_j V (i ≠ j)Є are called adjacent or neighbours if the link (e_{ij} = v1), v is a member of E (v_i, v_j) nodes.V_i Each sensor node has a unique ID such as address (MAC there).In the proposed protocol, all sensor nodes, are fixed (or with very low mobility), homogeneous and free-range radioRc.It is assumed that know all nodes are using GPS or other positioning algorithms of its geographical location, (xj, yj). Living well and not have energy constraints.

Geographical distance between neighbouring nodes:

Due to the location of sensor nodes, nodesi and j as a neighbour and well, the Euclidean distance between two neighbouringnodes, to the equation (1) can be calculated:

Formula equation

$$(1): dist(i,j) = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2}$$

In equation (1), (xi, yi) and (xj, yj) to the geographic coordinates of nodes i and j and dist (i, j) is the Euclidean distance between two neighbouring nodes.

Neighbours of nodei:

That node i to node distance is the smaller the node radio range. The set of NS (i) is shown. In other words, nodes that are in radio range of node i are thecomponents of its neighbour nodes that are considered. Neighbouring nodes of node i indicate that:

Formula equation

$$(2): NS(i) = \{j \mid dist(i,j)\} \leq R_c, i \neq j$$

In equationRc (2) node radio range dist (i, j) andit is the Euclidean distance between two neighbouring nodesi and j. In Figure 2, are significant the nodes within a circle of radius Rc and are located on neighbouring nodes of node i. Forward the message to node i:

The area where is the neighbour set of node i and nodes in the area are closer to the node i to the base station. This set the NS pos (i) is shown. The shaded area in Figure 2 is the same area. Forward the message to node i with equation (3) is expressed:

Formula equation

$$(3): NS^{pos}(i) = \{j \in NS(i): dist(j, \sin k) \leq dist(i, \sin k\}$$

Figure 2 to determine the effects of the post arc to the sink node i and radius dist (i, sin x) and we draw a circle with centre and radius Rc. Between the crosses, the area is known as a forward node i.

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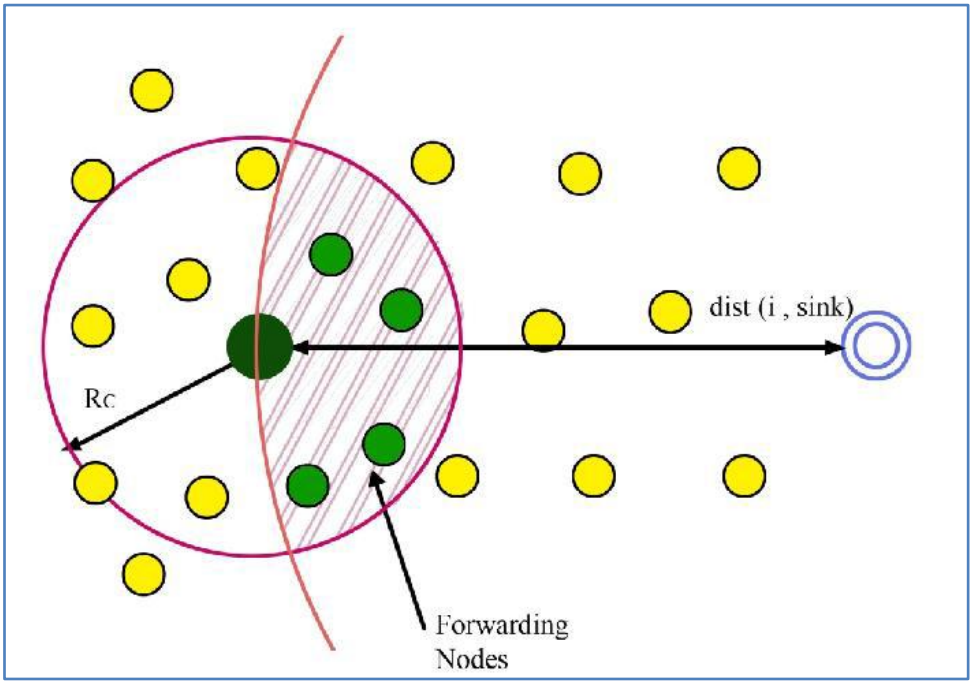

Figure 2: Forward the message to select a suitable node as the next node in the proposed approach.

In the proposed approach, will be delivered packets received from the application layer of the source nodethe previous packet sent from node to node to transmit to the next neighbour.In the proposed approach using a step by step geographically and is used to send packets. To write efficient in terms of energy consumption, the next node residual energy, is considered the energy needed for packet forwarding and packet sending interval. To write reliable for every packet sent, is higher quality the sending and multi-path communication links. Sensor nodes for data packet to determine its neighbouring nodes, are located locally specifications require neighbouring nodes that within its radio range. The first step of the proposed approach is generated by neighbouring nodes. Source node to its neighbours table and obtaining necessary information from neighbouring nodes in a single step, you create a positive distance to the progress, uses HELLO packets. Neighbour nodes, which source node located at the forward post, HELLO packet received to respond. In this protocol, is considered a precondition threshold (Eth) for energy nodes. The node ID node ID and node location is the geographic location of nodesand how to determine which will be described in the following sections. Free buffer, the source node and the neighbouring nodes indicates the traffic queue. Quality represents is the quality of the communication link between the source node to send and receive data and its neighbours. The same amount of energy is show remaining in the battery's remaining energy nodes, If the remaining energy is lower than the energy threshold Eth is added to the table will not be to its neighbouring nodes, this condition is leads to a balanced energy consumption of the nodes. The rate of supply from the neighbouring node to the next node messageis speed the message. Proposed protocol uses a cost function to determine the next appropriate node.In this protocol, with respect to collecting information from neighbouring nodes in a single step using HELLO packet checksumare usedto determine an appropriate node of the cost function for each neighbour node. Neighbour node is the maximum cost function value, will be considered the packets. Therefore, it is appropriate to transmit power and reliability, adequate cost function, is used according to Equation (4):

Formula equation (4):

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$$Cos\ t(i,j) = Max_{j\in N(i)}\left\{\alpha\left(\frac{E_{res}(j)}{E_{ini}}\right) + \beta\left(\frac{B_{free}(j)}{B_{ini}}\right) + \gamma(Pr\,r(j)\right\}$$

$\alpha + \beta + \gamma = 1$

$0 < \alpha, \beta, \gamma < 1$

3-1 Energy Consumption Model

Energy is one of the important parameters of wireless sensor networks. Energy since sensor nodes are supplied by the battery and is limited the battery life. Thus, the presentation of routing protocols, network lifetime, and therefore should be considered essential energy consumption.Kbit energy required to send a packet, the node with distance d, is calculated from equation (5):

Formula equation (5):

$$E_{TX}(k,d) = E_{TX-elec}(k) + E_{TX-amp}(k,d) = k(E_{elec} + E_{amp}\,d^{\alpha} = \begin{cases} k\left(E_{elec} + \varepsilon_{fs}\,d^2\right), \\ k\left(E_{elec} + \varepsilon_{mp}\,d^4\right) \end{cases}$$

In relation (5), d0 is the distance threshold value is equal to$d_0 = \sqrt{\frac{\varepsilon_{mp}}{\varepsilon_{fs}}}$

Eelec energy is required for digital coding, modulation and filtering. Energy consumed for receiving a k-bit packetis calculated by the receiver node of equation (6):

Formula equation (6):$E_{RX} = E_{RX-elec}(k) = kE_{elec}$

Therefore, is calculated the total energy required for sending and receiving a k-bit packet from equation (7):

Formula equation (7):

$$E_{total}(k) = E_{TX}(k,d) + E_{RX}(k) = \begin{cases} k(2E_{elec} + \varepsilon_{fs}\,d^2), d < d_0 \\ k(2E_{elec} + \varepsilon_{mp}\,d^4), d \geq d_0 \end{cases}$$

The relations (5), (6) and (7), are constant values Eelec and ε/mp, ε/ fs. To write efficient in terms of energy consumption and a neighbour is selected intermediate nodes compared to other nodes of greater energyand is to the destination, create positive progress geographical distance.

3-2 sends sure

To write reliable data, the proposed approach uses a multi-path and uses links with high reliability. To enhance the reliability and increase the rate of successful packets received at sink node, butsent to the sink multiple copies of the source node sends the packet and intermediate nodes have only incoming packets to the sink sends.In this case, can be calculated the probability of successful packet received at the sink node equation (8):

Formula equation (8):$P_s = \prod_{j=1}^{h} p_k^j$

In relation (8), Ps is the probability of a successful packet sent to the sink node through a step-by-step (with step h) to be posted. P j/k the probability of a successful packet is k sent to the j-th step of the

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path. It is usedto calculate the quality of the communication link between neighbouring nodes using the formula (9):

Formula equation (9):$PRR(t+1) = \lambda PRR(t) + (1-\lambda)\frac{s}{r+s}$

Number of steps is estimated needed to send a packet from source node i to sink node of equation (10).

Formula equation (10):$h = \frac{dist\,(i,\sin\,k)}{R_c}$

In relation (10), Rc the radio range of node and dist (i, sin k) is the Euclidean distance of node i to sink node. In a multi-path, in order to ensure the reliability of the package, (R req), must have at least one copy of the packets received by the sink node:

Formula equation (11):$1 - \prod_{k=1}^{N}[1 - P_s(k)] \geq R_{req}$

In relation (11), is closed N equals the number of paths required to meet the desired reliability of Rreq.

3-3 Performance Evaluation

To evaluate the effectiveness of the proposed approach is the use of the MATLAB simulation. Wireless sensor networksare symmetric using a multi-step and fixed sensor nodes. Sensor nodes are randomly and uniformly distributed in the environment and are aware of their location and remaining energy. Parameters necessary are to evaluate the proposed approach as shown in Table (1):

Table 1: Parameter values used in simulations

Type parameter	**Amount**
Number of sensor nodes	100 nodes
Simulation area	100m×100m
Location of sink	(0, 0)
Radio range of nodes	15m
The initial energy of the Knots	1 joule
E_{elec}	nj/bit50
E_{mp}	pj/bit/m210
Buffer size	6 Pack
Packet size	256 bytes
Data transmission rate	200 kbps
Type of traffic	CBR
Execution time	300 seconds

To compare the performanceof the proposed protocol ReInForM parameters measuredis including:

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3-4 Successful delivery rate, packet

The number of packets received at the destination relative to the total number of packets sent, are known packet delivery rate.It is showfigure 3 and 4 the reliability or the rate of packets delivered to the destination in the proposed protocolReInForm based on the error rate and the channel coefficients and different values. According to the simulation results of both methods are reduced increases the reliability of packet transmission channel error rate.It will beremoved number of packagesbecause with increasingchannel error rate.

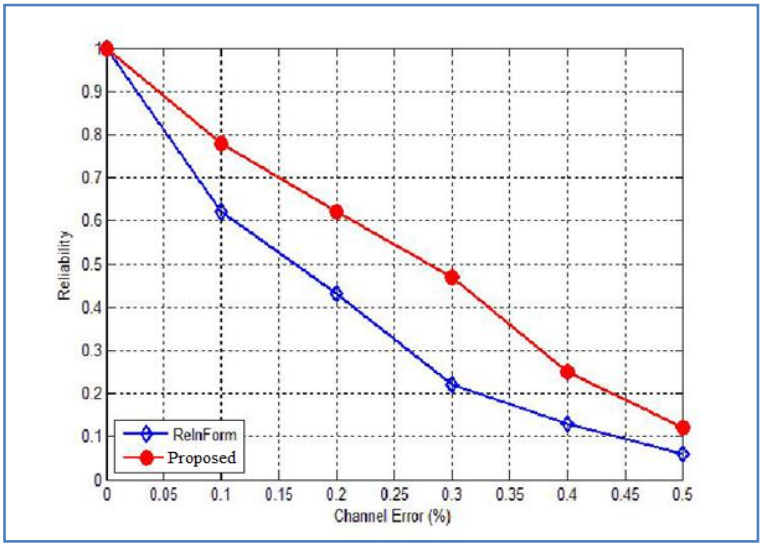

Figure 3: Graph reliability orpacket delivery rateat the destination under channel error rate

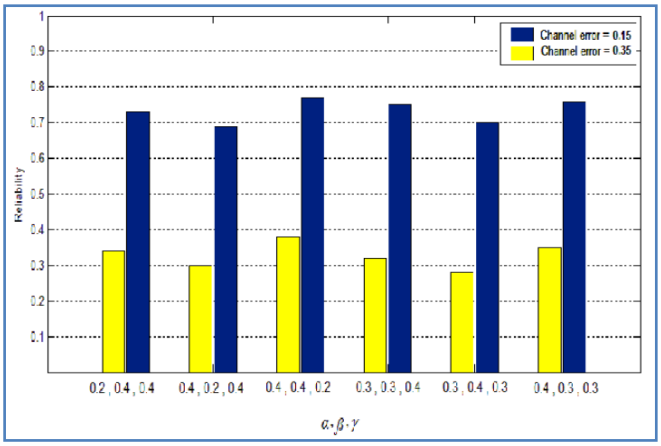

Figure 4: Graph reliability or packet delivery rate at the destination based on various factors

According to figure 3, the reliability of the proposed approach is higher than other methods. For this method, in addition to considering the quality of the communication link, the empty buffer, is considered the next neighbour node to send the packet. Thereby eliminated outgoing packets due to full buffer will be lost the next node. Figure 4 shows a plot of reliability based on the values of various coefficients. In this way, by choosing appropriate values for the coefficients of the cost function, is 0.15&0.35 maximum (α =0.4and β = 0.4 and λ = 0.4) Level of reliability for the channel error rate.

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3-5 the remaining energy

Figure 5 and6, amount of residual energy of the sensor nodesshow different values the channel error rates and the cost function coefficients. According to the simulation results and the energy level diagram in Figure 5 channel error rate decreases with the increase of sensor nodes. A channel error rate increase as the number of packets sent packets to provide greater reliability and thus increases the energy consumption of nodes.However, considers the proposed approach the amount of energy available to the neighbouring nodes in the selection of the next node a neighbour, a load on the nodes, and thus will be more nodes the amount of energy contained in the proposed approach.

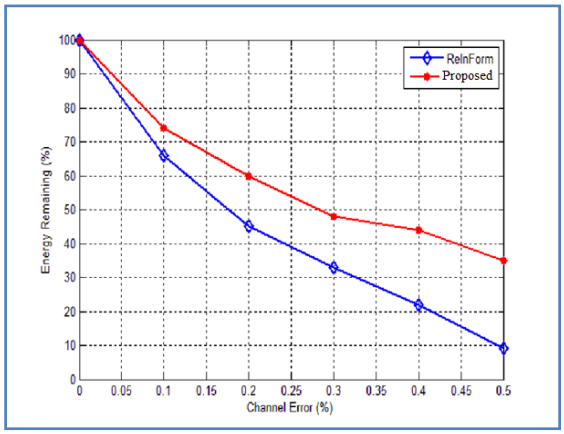

Figure 5: Diagram of the residual energy of the nodes based on the channel error rate

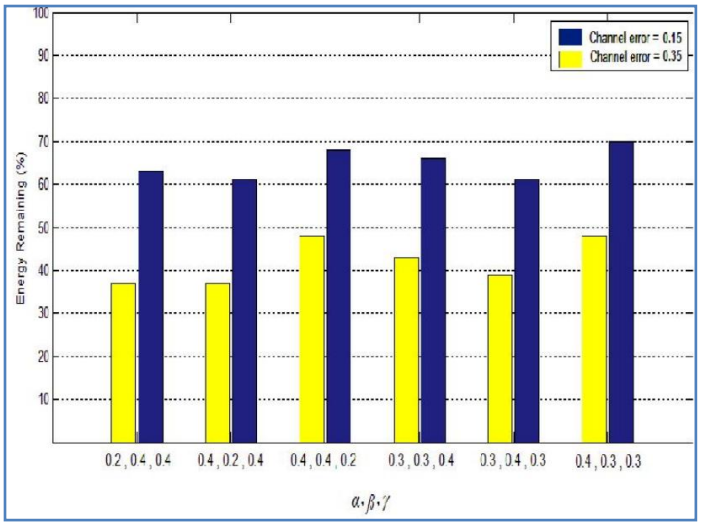

Figure 6: Diagram of the residual energy of the nodes based on various factors

Figure 6 shows the amount of energy available to sensor nodes its show based on the value of the cost function coefficients. According to the simulation results by choosing appropriate values for the coefficients of the cost function is maximized ($\alpha = 0.3$ and $\beta = 0.3$ and $\lambda = 0.4$) the amount of the available energy of nodes for channel error rate of 0.15 and 0.35.

4- Conclusions

Due to inherent limitations of the wireless sensor network, is provide the appropriate routing protocol for these networks a major challenge.In this paper, we provided a routing approach with the ability to increasing reliability and lifetime of the network routing capability.To increase reliability, is used

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decisions based on information from local groups and a few middle path without the need to discover and keep track of the end-to-end.The proposed approach for selecting the next node, is used an appropriate cost function which the function of communication parameters such as link quality, consideration energy and free buffer size of nodes into it.Simulation results show that to improve theproposed approach increases the rate of packets received at the destination and lifetime of the network.

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