July – August 2020
ISSN: 0193-4120 Page No. 3157 - 3169

Life Time of Agriculture System is maximized by Game Theory using Wireless Sensor Networks

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Abstract
Efficient energy utilization is crucially important in order to maintain a fully operational network for the shortest period to longest period of time possible. Therefore, network lifetime maximizationtechniqueshave attracted a lot of research attention. Thissyndicate technique ofgame on the rise and cropping, to determine the organisation of the game theory,with fitout and back fitting, to improve its generalization capabilities. The complete method is explained through classification of fertiliser rate, type of fertiliser and time. The theory produced by this method is significantly more accurate than standard game theory. Furthermore, a comprehensive model modification study expressions a much subordinate variance for game theory than for standard game as a direct cause of the improved accuracy.

Keywords: Wireless Sensor Networks, Game theory, agricultural Data, Paddy types.

1. Introduction

The planning of farmed networks is a relevant game theory problem that can be disintegrated in a categorization of household tasks, including the wireless sensor network design, frequency setting, development timetable growth, as well as harvest and formers setting up, in the middle of others. On the subject of crop network forecasting, a strong constraint for the harvest system is theobtain ability of fertiliser. In this sense, researchers usually focus on distributing a previously defined game theory of fertiliser into a given number of orders to define a crop network. Applications for this exact task usually consider one on its own objective function, such as the optimization of the regular time a former waits for a service. The preparation of metropolitan public agricultural systems also involves a series of real-world game theory problems that are usually tackled by human experts. One of these game theory problems is the harvest of a network in case of natural problems in fertiliser and former. For this particular task, instead of preplanning the whole harvest network if no further fertiliser or former exist, a simple solution involves studying the influence of transferring harvest or former from unaffected to affected ones.

Records show off is a collection of processes in which association among game theoriesuncovered by sensor networks. The goal of data show off is to use the growth of data to recondition future hard work. Use that data as a foundation to growth model to induced future forms. One of the strong

July – August 2020
ISSN: 0193-4120 Page No. 3157 - 3169

points of data show off is that it can analyze data from compound bases and give independent level growth regarding what is appropriate or not compulsory, that is for the model to agree. Model crop concern with creates a new algorithm to analysis data. The objective is to produce an overall instantaneous of a set ofgame theory data to identify and describe the main gain of features of the pattern.

2.Game Theory Techniques in Agriculture System using WSNs

The applications of WSN are huge vast and can be broadly classified into the monitoring and tracking categories. Applications of Monitoringare mainly include environmental monitoring such as fire detection in forest, biocomplexity mapping of environment, flood detection, precision agriculture. In health monitoring contains tele-monitoring of human physiological data, monitoring doctors and patients conditions and drug administration in hospitals.Inventory location monitoring is factory, machine, chemical and structural monitoring. In Military monitoring the equipment and ammunition, battlefield, terrain surveillance, opposing forcesofreconnaissance,battle damage assessment ,targeting, , nuclear, chemical andbiological attack detections all are included. The Tracking applications also include objects, animals, humans, vehicles, and military enemy tracking.

These applications are mainly made up of the fact that WSN has a short system setup time and sensors can be disposed with acceptable operational cost.Here we mainly survey the state-of-the-art routing protocols foragriculture system by WSNs. In general, agriculture systemin WSNs by using game theory can be divided into at-based routing, hierarchical-based routing, and location-based routing depending on the network structure. In at-based routingall the nodes are typically assigned by equal roles.

In hierarchical-based routing, however, the nodes will play different roles in the agriculture paddy system. In location-based routing, sensor nodes levels are exploited to route data in the agriculture system. The routing protocol in certain agriculture system parameters can be controlled in order to adapt the current network conditions and current available energy levels. These protocols can be classified into multipath-based, query-based, negotiation-based, QoS-based, routing techniques depending on the protocol operation of agriculture system.

In addition to the above, cooperative and non-cooperative game theory routing protocols can be classified into three categories.The three categories are proactive, reactive, and hybrid protocols are depending on the source ends a route to the destination. In the proactive cooperative and non-cooperative game theory all the protocols, all routes are computed while in reactive protocols, routes are computed on demand.Combination of Hybrid protocols is also used.

If sensor nodes are static, it is mainly preferable to have table driven cooperative and non-cooperative game theory routing protocols rather than the used reactive agriculture system. A typical amount of energy is used in route discovery and setup of reactive protocols. The class of routing protocols is called the cooperative and non-cooperative game theory routing protocols in agriculture system. In cooperative and non-cooperative game theory routing, nodes send data to a central node where data can be aggregated and may be subject to further processing, hence reducing route cost in terms of agriculture system use. In this survey paper, we use a classification according to the agriculture system structure and protocol operation.

3.Agriculture System: Cooperative and Non-Cooperative Game Theory

The objective of energy-aware routing protocolagriculture system, a destination initiated reactive protocol, is to increase the agriculture system lifetime. Although this protocola_i; is similar to directed diffusion, it differs in the sense that it maintains a set of crabs instead of maintaining or enforcing one optimal path at higheryields. These paths are maintained and chosen by means of a certain agriculture systemprobability. The value of this agriculture systemprobability depends on how low the energy agriculture system of each path can be achieved. By having paths chosen at different times, the energy of any agriculture systemwill not deplete quickly. This can achieve longer agriculture system lifetime as energy is dissipated more equally among all nodes. Agriculture systemsurvivability is the main metric of this protocol. This protocol assumes that each and every node is a class-based addressing which includes the location and types of the nodes. The protocol connection initiates a localized flooding, which is used to discover all routes between source/destination pair and their costs. The high-cost yields are discarded and a forwarding table is built by choosing neighboring nodes in a manner that is proportional to their cost. Forwarding tables are mainly used to send data to the destination with a probability that is inversely proportional to the node cost.The destination node Localized flooding is performed by to keep the paths alive. When compared to directed diffusion, this protocol provides an overall improvement of 30% energy saving and 90% increase in agriculture system lifetime. However, the approach requires gathering the location information and the addressing mechanism for the nodes, route setup compared to the directed diffusion.

3.1. Cooperative and Non-Cooperative Game Theory agriculture systemGathering in Sensor Information Systems (ASGASIS):

Cooperative Game Theory based approach

To decrease the energy consumed in the network, some sensor nodes cooperate to form coalitions. The coalitional game is considered as one of the most significant type of cooperative game theory. Ina power control game theoretic model is proposed to optimize the trade-off between energy consumption, and data packets transmission performance. Each sensor player takes in consideration of the individual utility. A novel approach is proposed in to identify the overlapping community form in social networks. This approach is based on the shapely values mechanism. It activates with a weight function to find the stable coalitions of underlying community form of the network. The shapely values and the weight function are updated by the community detection algorithm using the local information. Another type of cooperative game is the bargaining game theory. To achieve the two opposite objectives, which are prolonging the WSN lifetime and maintaining the quality of the sensors activities in parallel.

Non-Cooperative Game Theory based approach

For the non-cooperative game theory, sensor nodes react selfishly to preserve their residual energy by refusing to receipt a data information and forward it in multi-hop network. In non-cooperative game theoretic the optimal responses for energy efficient are obtained when each sensor player improves its strategy to maximize its utility, given the strategies of other sensors players. In a non-cooperative game theory model is proposed to control the transmit power levels and the Nash Equilibrium solution exists and attained according to the channel

July – August 2020
ISSN: 0193-4120 Page No. 3157 - 3169

condition and power level. In addition, a non-cooperative game theory is used in the election of the CHs for the clustering model in In this game model, the sensor node decides to declare itself as a CH or not by calculating the optimal probability in the mixed strategy that depends on the maximizing of its payoff. In addition to the non-cooperative and cooperative game theories, the repeated game theory is involved with a class of active games, in which a game is played for several times and the players have the ability to spot the result of the preceding game before attending the upcoming repetition. In a control scheme based on reinforcement learning and game theory is proposed as a routing game model to provide a packetforwarding mechanism for underwater wireless sensors network and reduces the energy consumption.

The optimal chain-based LEACH protocol was proposed in Agriculture SystemGathering in Sensor Information Systems (ASGASIS). The basic idea of the protocol is that in order to extend agriculture systemlifetime. Here nodes are only communicated with their closest neighbors and they take turns in agriculture system with the base-station. They will reduce the expense required to transmit data per round as the power draining is spread uniformly over all agriculture system. The two main objectives arefirst to increase the lifetime of each agriculture system by using collaborative techniques of the lifetimeof agriculture system will be increased. Second they allow only local coordination between nodes that are close together so that the bandwidth consumed in expenses is reduced. LEACH& ASGASIS avoids cluster formation and uses only one node in a chain to transmit to the base station instead of using multiple nodes.

Each nodein ASGASIS adjuststhe agriculture systemto measure the distance to all neighboring nodes so that only one node can be heard. This chain in ASGASIS will consist of the aggregated form of the data will be sent to the base-station by any node. The chain construction is performed and thesimulation results showed that ASGASIS is able to increase the lifetime of the network twice as much the lifetime of the agriculture system under the LEACH protocol.

The gain is achieved through the elimination of the overhead caused by dynamic cluster formation in LEACH,although the clustering overhead is avoided. ASGASIS still requires cooperative and non-cooperative game theory adjustment. In practical cases, a sensor node needs to know about energy status andmultichip communication to reach the base-station. Also, ASGASIS assumes that all nodes maintain a complete database about the location of all other nodes in the agriculture system.

In addition, ASGASIS assumes that all sensor nodes have the same level of energy and they are likely to die at the same time and introduces excessive delay for distant node on the chain. The most scenarios, sensors will be fixed or immobile as assumed in ASGASIS, some sensors may be allowed to move and hence arrest the protocol functionality. It is an extension to ASGASIS, called Hierarchical-ASGASIS was introduced with the objective of decreasing the delay incurred for packets during transmission to the base station. For this purpose, simultaneous transmissions of data are studied in order to avoid collisions through approaches that incorporate agriculture system and spatial transmissions.

In the later, only spatially separated nodes are allowed to transmit at the same time to constructs a chain of nodes that forms a tree like hierarchy. This method ensures data transmitting in parallel and reduces the delay significantly. Such

July – August 2020
ISSN: 0193-4120 Page No. 3157 - 3169

hierarchical extension has been shown to perform better than the regular ASGASIS scheme by a factor of about 70.

3.2. Cooperative and Non-cooperative Power Control Game

We formulate the users' selfish behavior with a cooperative and non-cooperative game framework. Let $G = [N, (P_i), \{(u_i)(.)\}]$ denote the cooperative and non-cooperative power control (CANPC) game where N= {1,2,…N} is the index set for active users currently in power control networks, P_i is the strategy set, and $\{(u_i)(.)\}$ is the utility function of user i. each users selects a power level $p_i\ \varepsilon\ P_i$. Let the power vector $p = p_1, p_{2,.........}p_N\ \varepsilon\ p$ denote the outcome of the cooperative and Non-cooperative Power Control Game in terms of selected power levels of all the users, where P is the set of all power vectors. The utility function demonstrates the strategic interdependence among users. The level of utility each user gets depends on its own power level and also on the choice of other players' strategies, through the SINR of that user. We assume that each user's strategy is rational, that is, each user maximizes its own utility in a distributed fashion. Formally, the CANPC game G is expressed as

$\max_{p_i\ \varepsilon\ P_i.} u_i(P_i, P_{-i})$, for all iεN, ------------------------ (1)

Where u_i is given in (1) and $P_i = \{p_i^{min}\ p_i^{max}\}$ is the strategy space of user i. In this game p is the strategy profile, and the strategy profile of i's opponents is defined to be $(P_{-i} = P_{1,}P_{i-1},\ P_{i+1}, \dots\dots\dots\ P_N)$, so that $P=(P_i, P_{-i})$.A similar notification will be used for other quantities.

Users i's best response is $BR_i(P_{-i}) = \arg\max_{p_i\ \varepsilon\ P_i.} u_i(P_i, P_{-i})$, i.e., the P_i that $\max u_i(P_i, P_{-i})$ given a fixedP_{-i}. With the best response concept, we can present the following definition for the Nash Equilibrium (NE) of CANPC game G.

Definition.1Nash Equilibrium (NE) of CANPC game G

A strategy profile p^* is a Nash Equilibrium (NE) of CANPC game G if it is a fixed point response, $u_i(p_i^*, p_{-i}^*) \geq u_i(p_i^{'}, p_{-i}^*)$ for any $p_i^{'} \varepsilon P_i$ and any user i.

The NE concept offers a predictable, stable outcome of a game where multiple agent with conflicting interests complete through self- optimization and reach a point where no player wishes to deviate. However, such a point does not necessarily exist.

Definition. 2.Cooperative and Non-Cooperative Game Theory Energy efficiency

Sensor nodes are equipped with small non-rechargeable batteries (usually less than 0.5 A h and 1.2 V). Therefore, theefficient battery utilization of a sensor node is a critical aspect to support the extended operational lifetime of the individualnodes and of the whole network. A WSN routing protocol is expected to: (i) minimize the total number of communications involvedin route discovery and data delivery, and (ii) distribute the forwarding of the data packets across multiple paths, sothat all nodes can deplete their batteries at a comparable rate. This will result in the overall increase of the network lifetime.

3.3. Cooperative and Non-Cooperative Game Theory Best-effort and QoS-aware routing

Protocols that do not provide any guarantees in terms of quality of the service delivered to the application are categorizedas best-effort. Protocols that can provide to the application routing services with quality guarantees (e.g., in terms of end-to enddelay, delay jitter, available

July – August 2020
ISSN: 0193-4120 Page No. 3157 - 3169

bandwidth, packet losses, etc.) are indicated as QoS-aware.

3.4. COOPERATIVE AND NON-COOPERATIVE POWER CONTROL GAME THEORY

Acooperative and Non-Cooperative Game Theory is based on the absence of coalitions in that it is assumed that each participant acts independently, without collaboration or communication without any of the others. Because transmission cooperative and non-cooperative power choice of transmission in wireless sensor networks in the problem of cooperative and non-cooperative power control game theory with incomplete information, we can have following result by using Bayesian Nash Equilibrium method.

Theorem.1. Nash Equilibrium exists and is unique in cooperative and non-cooperative power control game with incomplete information of transmission power control.

Proof

Let f_{s_i}(x) as the probability density function of s_i, assuming that node can carry out data transfer under any large cooperative and non-cooperative power condition, that is when $s_i \to \infty$,node transmission probability is 1,so we can have $\int_0^\infty f_{s_i}(\text{x})\text{dx} = 1$.

But cooperative and non-cooperative power control game theory in the real world, in order to reduce the payments as well as reduce cooperative and non-cooperative power costs, does not allow the node forward at any big cooperative and non-cooperative power value. So we should let transmission cooperative and non-cooperative power within a certain range, we can assume that when cooperative and non-cooperative transmission power as $s_i \in [0,p_i]$, the n_i will get the largest cooperative and non-cooperative networks utility. $p_t$is the maximum power when a node transmits can be given by

$$\text{P}\ (p_t) = \int_0^{p_t} f_{s_i}(\text{x})\ \text{dx} \qquad (2)$$

The probability of no transmission is 1- P (p_t). So the probability that any k nodes out of N nodes are active is given by

$$p_n = \sum_k \binom{n}{k} (\ \text{p}\ (p_t)^k)\ (1\text{-}\ p(p_t)^{N-k}) \qquad (3)$$

Then the expected cooperative and non-cooperative networks utility of the i^{th} node transmitting is given by

$$\text{E}[U_i^{net}] = \sum_{k=o}^{N} (u_i(s_i, s_{-i}) - A(s_i))\, p_k \qquad (4)$$

If the node is transmitting expected cooperative and non-cooperative networks utility is equation (5). If the node dose not transmit the expected cooperative and non-cooperative networks utility is 0. The expected cooperative and non-cooperative networks utility of any node is given by

$$G_i(p_t) = \int_{z_i}^{p_t} [U_i(p_t) - c(x)] f_{s_i}(x)\, dx$$

$$= U_i(p_t)\ \text{p}(p_t) \int_{z_i}^{p_t} c(x)] f_{s_i}(x)\, dx \qquad (5)$$

Let B (p_t) =$\int_{z_i}^{p_t} c(x) f_{s_i}(x) dx$, then the equation (8) can be written as

July – August 2020
ISSN: 0193-4120 Page No. 3157 - 3169

$G_i(p_t)$ $=U_i(p_t)$ p(p_t) $-$ B (p_t) -------------------------------------- (6)

From the equation (9) we can see that when the actual transmission power reach the value of upper bound, we get same expected utility, i.e., s_i=p_i. Thus p_i is the power upper bound of nodes transmitting when the whole network can achieve maximum utility? That is p_t is the solution to following equation

$U_i(p_t)$ $-$c(p_t) = 0 ---------------------------------- (7)

Theorem.2.

Nash equilibrium exists is unique in cooperative and non-cooperative game with incomplete information of transmission power control.

Proof

Let us suppose(T_1),(T_2) be transmission cooperative and non-cooperative game power of each node, of which (T_1) is the solution to equation (10), (T_2) is any cooperative and non-cooperative game power, and $(T_1) \neq (T_2)$, then the average cooperative and non-cooperative game power utility of the node when $(s_i) = (T_1)$ and $(s_i) = (T_2)$ as follows,

$$(G_i)(T_1)= \int_{z_i}^{T_1}[U_i(T_1) - c(x)]fsi(x)\, dx=[Ui(T1)\, P(T1) \ -B(T1)$$

$$(G_i)(T_2)= \int_{z_i}^{T_2}[U_i(T_2) - c(x)]f_{s_i}(x)\, dx$$

$$=[U_i(T_1)\, P(T_2) \ - B(T_2)$$

We can get the following equation

$$(G_i)(T_1) - (G_i)(T_2) = \{[C(T_1)\, P(T_2) \ - B(T_1)] - [C(T_1)\, P(T_2) \ - B(T_2)]\} \text{ ----- } (8)$$

$$=\mathrm{C}(T_1)[\, P(T_2) \ - P(T_2)]\text{-B}[(T_1) \ - B(T_2)]$$

(1) When $(T_1) > (T_2)$ equation (11) can be written as

$$(G_i)(T_1) - (G_i)(T_2) = \int_{z_i}^{T_1}[U_i(T_1) - c(x)]f_{s_i}(x)\, dx - \int_{z_i}^{T_2}[U_i(T_2) - c(x)]f_{s_i}(x)\, dx$$

$$= \int_{T_2}^{T_1} C(T_1) - c(x)]f_{s_i}(x)\, dx$$

Because C (s_i) is monotone increasing function of powers_i, when for all x$< (T_1)$, we get c(x)$< c(T_1)$. Therefore

$(G_i)(T_1) - (G_i)(T_2)$ >0 When$(T_1) < (T_2)$ equation (11) can be written as

$$(G_i)(T_1) - (G_i)(T_2) = \int_{z_i}^{T_1}[U_i(T_1) - c(x)]f_{s_i}(x)\, dx - \int_{z_i}^{T_2}[U_i(T_2) - c(x)]f_{s_i}(x)\, dx$$

$$= \int_{T_2}^{T_1} C(T_1) - c(x)]f_{s_i}(x)\, dx$$

Then $(T_1) < x < (T_2)$, we get C (T_1) <C(x). Therefore $(G_i)(T_1) - (G_i)(T_2)$ >0

July – August 2020
ISSN: 0193-4120 Page No. 3157 - 3169

Based on the above two cases, we can see that for any power (T_2), if for all $(T_2) \neq (T_1)$, then $(G_i)(T_1) > (G_i)(T_2)$, so (T_1) is the selected cooperative and non-cooperative power when the network achieve the maximum net utility, no cooperative and non-cooperative power expect for (T_1) can provide expected utility. That is (T_1) is the solution of incomplete information cooperative and non-cooperative power control of Nash equilibrium as well as the unique solution.

4. SIMULATION AND PERFORMANCE ANALYSIS

The proposed algorithm has been simulated and validated through simulation. The sensor nodes are deployed randomly in a 100 ×100 meters square and sink node deploy at the point of (50, 50), the maximum transmitting radius of each node is 80m; other simulation parameters are displayed in **Table.1**. In this section, we first discuss utility factor and pricing factor's influences on transmitting power, then evaluate the algorithm of NGLE algorithm and compare it with other existing algorithm.

Table 1 Simulation Parameters

Parameters	Value	Parameters	Value
Transmission Range	250 m	Receiving Power	36 mW (129.6J)
Network Area	100 × 100	Power Consumption in Sleep mode	100 μ W (0.36J)
Number of Sensors	50 – 100	Sending and Receiving Slot	50 msec
Packet rate	5 pkt / sec	Type of mote	$Mica^2$
Packet Size	50 bytes	Initial energy of sensor node	2KJ
Radio Bandwidth	76 kbps	Energy Threshold E^{thd}	0.001mJ
Transmitting Power	75 mW (270J)		

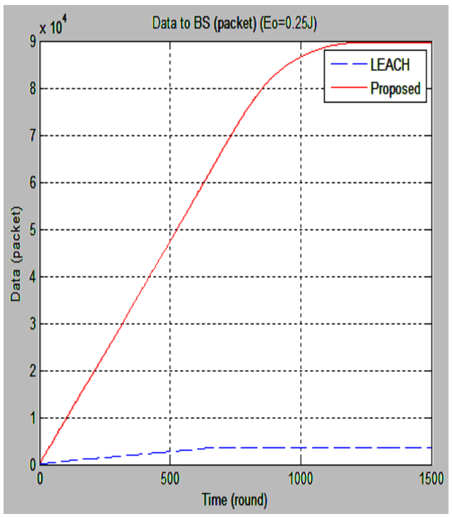
The Network Lifetime for each simulation is showed in **Figure 2**. These curves are showing that lifetime of network for various routing protocols after 500 rounds, about 30% of nodes in the network are alive in the proposed REER routing protocol, but 1%, 7%, and 10% of nodes are alive in existing protocols LEACH, LEACH-M and HEED respectively. So the network lifetime is increasing about 80% with using of our model and algorithm.

Figure 3 shows the average delivery delay with increasing transmission rate. The average delivery delay means the average time delay between the instant the source sends a packet and moment the destination receives this packet.

July – August 2020
ISSN: 0193-4120 Page No. 3157 - 3169

Table2. Comparison LEACH protocol and Proposed protocol withE_0 = 0.25J

Protocol	Stability	Network	Instability
LEACH	440	700	250
Proposed protocol	700	1229	540



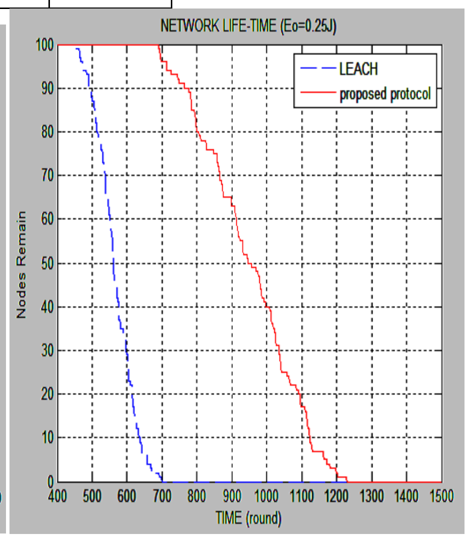


Fig 2. Compare network life-time Fig3. Data to BS between LEACHbetween LEACH and Proposed
Protocol and proposed protocol (E_0= 0.25J)

When the transmission rate is 1 packet per second, we can see that the average delivery delay of LEACH, LEACH-M is lower than the proposed REER protocol and HEED. This is because LEACH is always tries to discover a high speed path for forwarding packets. Since the transmission rate increases, the average delivery delay of LEACH increases significantly. This is because congestions occur at the intermediate nodes in LEACH. In the proposed protocol, when the packets reaches at destination, the relay or intermediate nodes have a lower forwarding probability than normal nodes by using multiple strategy. In the forwarding node selection game, the probability that a great amount of packets are forwarded by the same node is relatively low. Thus, the average delivery delay of our protocol does not significantly increase with an increase in transmission rate.

Figure 4shows the Energy Consumption of the four protocols. For LEACH, LEACH-M and HEED protocols, the source always selects the node closest to the destination in the neighbor set. However, normally the closest node is the local superior decision, not the global optimal decision. For our protocol, in the forwarding node selection game, if some node has a lesser angle with the line formed by source and destination, it has the high probability to be the forwarding node. Thus, the proposed REER protocol consumes less node energy for transmitting data between the nodes.

Figure 5 shows the Packet Delivery ratio of proposed protocol is compared with existing protocols. The plot infers that the proposed REER protocol has better performance than LEACH, LEACH-M and HEED. With the increase of transmission rate, LEACH, LEACH-M and HEED always forward packets along the relay nodes by perimeter approach. This leads to a high probability of packet congestion around the relay node. In REER protocol, since the process of forwarding node selection is a game process, the source has lower probability to make the same candidate gain too much benefit from the game process. This is the reason the packet delivery ratio of our protocol does not significantly decrease with the increase of transmission rate.

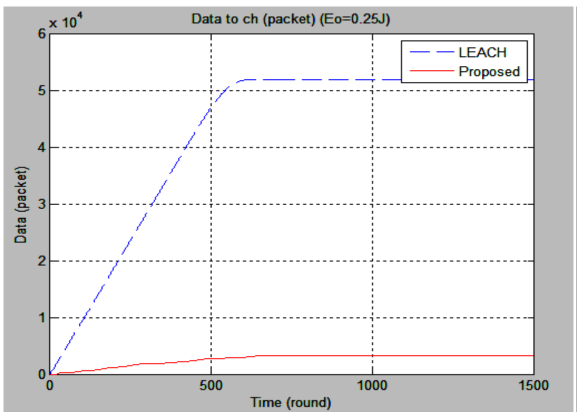


Fig.4. Data to CH between LEACH And proposed protocol (E_0= 0.25J)

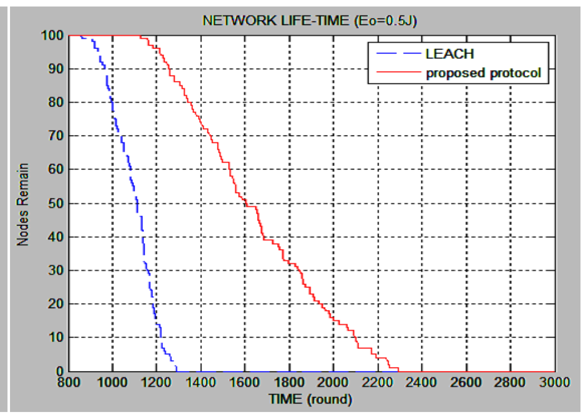


Fig.5. Compare network life-time between LEACH and Proposed protocol (E_0= 0.5J)

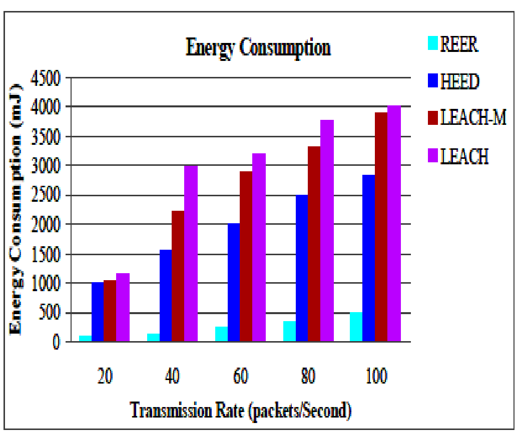


Fig 6. Energy Consumption Ratewith various Transmission Rate

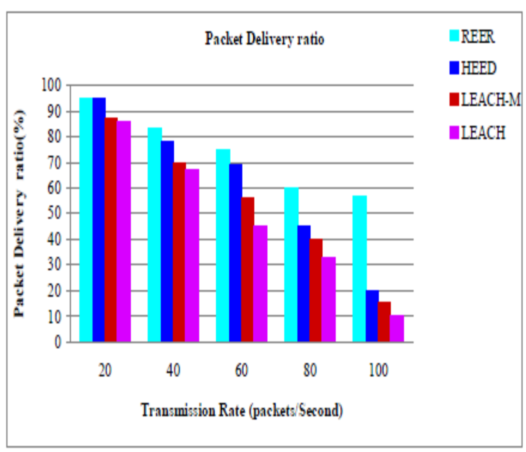


Fig 7. Packet Delivery rat isWith various Transmission

Figure 6 andFigure 7, shows the Energy Consumption with various transmissions. This is one of the major parameter to be considered in case of wireless sensor networks as the sensors sense information throughout the day the

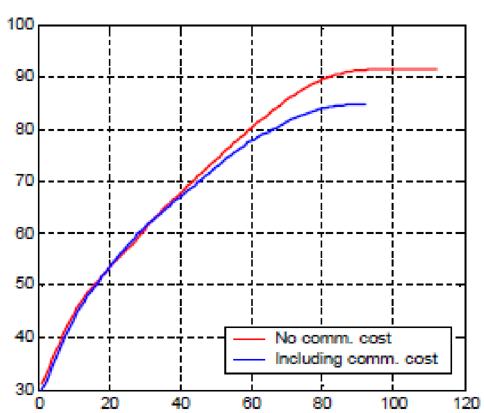
July – August 2020
ISSN: 0193-4120 Page No. 3157 - 3169

energy saving is very important, retransmission of each and every sensor should be reduced to make the power consumption will be low which is not fair in case of tiny sensor nodes. Remote application sensors are to charge through environment, like solar cells. Packet Delivery Ratio with various transmissions Rate is a very important metric for evaluating the network performance of the reliability mechanism of routing protocols. This makes the ratio of the total number of packets received by each subscriber node, up to the total number of packets generated by all nodes of the events to which the transmitter node has transmitted. It won't consider duplicated or repeatedly transmitted packets received by transmitter nodes.

Figure7, **Figure8**, and **Figure9**, shows the Energy Balance Factor with various transmissions. Energy Balanced Factor (EBF) of FAF increase slowly with light variation at first and keep a stability, then increase a little time, and return to 0 as the energy of the entire network is using up. In this network first death of node occur at the stage of 300 rounds. EBF is defined as the average of all nodes standard deviation based on residual energy. It's the average value of the residual energy of all of the nodes. The result of simulation show that, proposed protocol in creed network life-time up 75% compared with LEACH protocol. To evaluate the effect of the proposed protocol, we use some following parameter to measure simulation results. Those are 10% Node Dead (TND), Haft Node Dead (HND) and Full Nodes Dead (FND).

Table 3. Compare TND, HND and FND between LEACH and Proposed protocol with E_0= 0.25J

Parameter	10% Dead	50% Dead	100% Dead
LEACH	490	550	690
Proposed protocol	760	940	1220



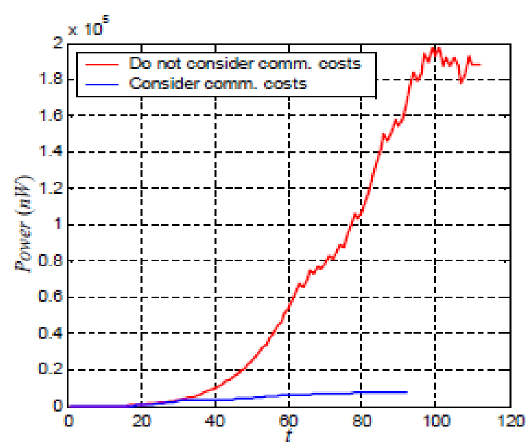


Figure 8. Comparison of sensing coverage **Figure 9.Comparison of communication costs**

According to the simulation results, the initial energy is 0.25J. In compare with LEACH protocol, proposed protocol increases TDN by 60%, HND by 68% and FDN by 80%.

July – August 2020
ISSN: 0193-4120 Page No. 3157 - 3169

Table 4. Compare TND, HND and FND between LEACH and Proposed protocol withE_0 = 0.5J

Parameter	10% Dead	50% Dead	100% Dead
LEACH	960	1111	1280
Proposed protocol	1250	1600	2290

With initial energy E_0= 0.5J, the proposed protocol can make network lifetime increase,respectively 35%, 44% and 80%. We see that the proposed protocols perform better than LEACH protocol.

5 CONCLUSION

In this chapter, we introduce a Cooperative and Non-Cooperative Game Theory for extending sensor network lifetime. This approach improves the transmission success rate and decreases the transmission delays of packets. In the aspect of setting up the routing path, we consider the residual energy. We conclude the forwarding probability and payoff function of forwarding participants. We proposed a new routing protocol in order to enlarge the life-time of sensor networks. This protocol developed from LEACH protocol by considering energy and distance of nodes in WSN in CHs election. However, this protocol is only applied in the case of BS in the sensor area. But with BS is far from sensor area, we cannot apply this protocol. In the future, we will study the energy distribution of node in the case BS is far from the sensor area to improve the lifetime of the whole network. Finally, the Nash Equilibrium exists when it is assumed for minimum and maximum threshold for channel condition and power level. By using Non-Cooperative and cooperative Game Theory, the network lifetime is extended, that is after 500 rounds, 27% of nodes are alive where as 1%, 5% and 7% of nodes are alive in existing protocols LEACH, LEACH-M and HEED respectively. So the network lifetime is found to be increasing about 83% with the applications of our model and algorithm.

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