ISSN No. 0976-5697

Volume 6, No. 6, July - August 2015

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

Minimal Energy Consumption by WSN Nodes during Communication using LEACH and NetLogo in Intelligent Greenhouse

Akash Jeewan,
M.Tech Scholar
DWCE, E&C Branch,Suresh Gyan Vihar University
Jaipur, India

Rashid Hussain,
Associate Professor
E&C Branch,Suresh Gyan Vihar University
Jaipur, India

Abstract: WSN in recent years has been one of the most potential and reliable technologies for agricultural farms. WSN technologies must be low in energy consumption to increase their working lifetime. During communication maximum energy is consumed. To minimize energy consumption, LEACH protocol has been used with a different concept. Here nodes and cluster head (CH) along with core nodes (CN) are sent to sleep or ready mode as per requirement. Multi hop concept is used. This concept of communication can be used in greenhouse agriculture as data transmission occurs every time, thus aiming at minimum energy consumption. NetLogo has been used for showing nodes behavior when it acquires or looses energy.

Keywords: WSN, LEACH, NetLogo, Precision Agriculture, ZigBee and GSM.

I. INTRODUCTION

India is a country where the livelihood of the farmers depend solely on agriculture. It is a well known fact that around two-third [4] of Indian population depend on agriculture for employment. Unfavorable weather conditions deteriorate conditions to worst. So in order to improve farmers conditions we need to improve the standards of farming in agricultural fields. WSN has been proved to be a great potential for farming. This technology is flourishing with great intense for improving the growing conditions of all varieties of crops [5]. WSN sensors are installed inside greenhouse to monitor different parameters for the growing crops. Parameters such as temperature, humidity, light, water level and soil moisture are measured and monitored in real time [5]. Farmers can easily monitor the parameters on the LCD display or via SMS through GSM technology if residing far from farm field.

The techniques of WSN applied in agriculture assists to gather distributed data, monitoring of crops in harsh environment, production with minimum cost. Two or more greenhouse models can communicate with each other and share their relevant data with the help of GSM technique. ZigBee helps to connect two or more greenhouse models with each other [6]. This process happens with the help of SMS via GSM. WSN has become very popular as it is scalable and easy to handle in automation and control applications. Also as communication will take place for transferring data, minimum energy consumption should be done. For this, a concept has been applied to LEACH protocol [1, 2]. NetLogo, an agent based modeling tool is available free. It is an open source program. It has been used for modeling and stimulating complex systems [7, 8].

II. INTELLIGENT GREENHOUSE

Under this concept less problems of the changing weather conditions is faced by farmers. A system for increasing the quality of agricultural yield by monitoring soil and environment conditions could be designed was explained by Blackmore et al. in 1994 [3]. Using these concept farmers can grow different crops easily and efficiently all over the year. Farmers will be able to grow seasonal as well as unseasonal crops irrespective of outside environmental conditions. Main objective of this concept is monitoring and controlling the environments as per the crop requirements. A crop may undergo different stages of growth under greenhouse conditions. Greenhouse concept is an upcoming technology in Precision Agriculture for growing crops with high quality. PA model is designed using WSN nodes. These sensor nodes help in collecting spatial data, controlling irrigation parameters, sending information to farmers, etc.

III. PROPOSED WORK

To monitor various parameters in greenhouse the system needs to be very efficient and energy consumption by the sensors should be minimum. In this paper, I have divided my work in two sections: 1) Proposed model & 2) Proposed concept.

A) Proposed model

Four different parameters were taken for measurement purpose in greenhouse environment. The hardware shown below comprises of various parameters such as light, humidity, temperature and water level. Readings of all these parameters are shown on the LCD screen one by one.

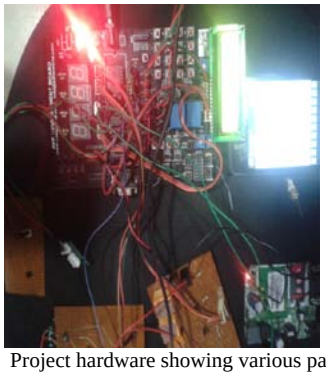

Figure 1. Project hardware showing various parameters

Initially, the circuit was connected as per the circuit diagram and all the connections were checked and then the

procedure was further proceeded. The GSM module is connected to the power supply with a SIM initially inserted in the module. The atmega16 is also given power supply.. It receives data from the microcontroller, transmits the data, in form of signals, by using SIM to the destination.

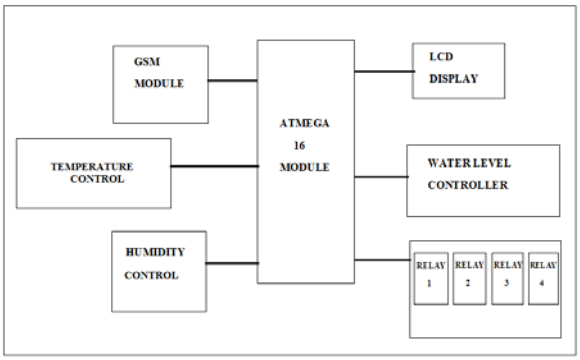

Fig. 2 Block diagram of proposed model

1) Working of GSM module: Initially SIM was inserted into GSM module and then power was supplied. LED lights were seen blinking. Blinking shows that it searches for the network. If blinking occurs once in three seconds then it means that the network has been setup. Now the module is ready for sending messages i.e. it's ready for communication. Now with the number saved in the SIM, the user sends a message to that SIM number. After few seconds the receiver will receive the message displaying readings of the mentioned parameters.

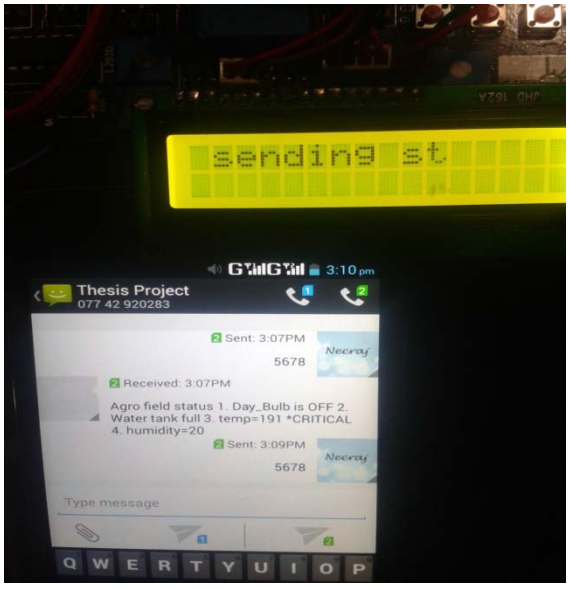

Figure.3. Message sent via GSM to phone

B) *Proposed Concept*

While sending data energy consumption takes place. Consumption of energy depends on various factors such as length of data, redundancy of data and congestion in the network. So in order to reduce energy consumption following idea can be applied.

LEACH protocol can be used with some improvements in it. Aggregation of data will not occur in Cluster Head as maximum energy is consumed. Instead the neighbor nodes will combine same data by taking average of it or if different data is present then it will be combined in one single packet. If the size of the packet is big then it can be divided into small transmittable segments. Nodes which will finally collect the aggregated data will be called as core node. This core node will then transmit the data to Cluster Head. Reason behind this is that transmission of data will result in multi-hop transmissions. In single hop maximum energy is consumed. Multi-hop will result in minimization of energy consumption by the nodes. Also nodes which are free from work can be sent to sleep mode or ready mode till the requirement of that

Also different data can be wrapped up in one single packet.

This concept can be used in greenhouse for sending or receiving of data. As frequent transmissions of changeable values of certain parameters are done, so minimum energy consumption should be achieved.

Energy consumed by CH in sending and receiving L bit/s packet is

$$P = L (2E_J + E_P + E_A \times S^y).$$

Where, L is length of packet (bits) and S is the transmission distance (m).

So, minimum the value of L and S, minimum will be the energy consumption by the nodes and will thus increase nodes lifetime.

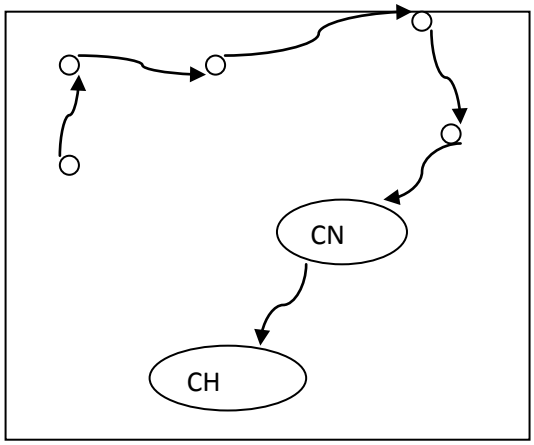

Figure.4. CN sends data to CH

Figure 4 shows that the core nodes collect the data from nodes. Aggregated data from core nodes is sent to cluster head. A s nodes collect data from nearby nodes so multi-hop concept is followed. This reduces energy consumption. CN is known as core node and CH is the cluster head. In LEACH, aggregation of data used to take place in CH. It consumed maximum energy as it used to follow single-hop communication. This resulted in wastage of energy of nodes. As sensor nodes are not rechargeable, so single-hop communication should be avoided. Now the number of core nodes depend on the complexity of the cluster. If the nodes can be managed by single CN then only one CN will be used. But if the complexity of the cluster increases then the number of core nodes will also increase accordingly as shown in figure 5.

Now when average of same data will be taken and sent from greenhouse to the destination there will be some amount of energy saved by WSN nodes.

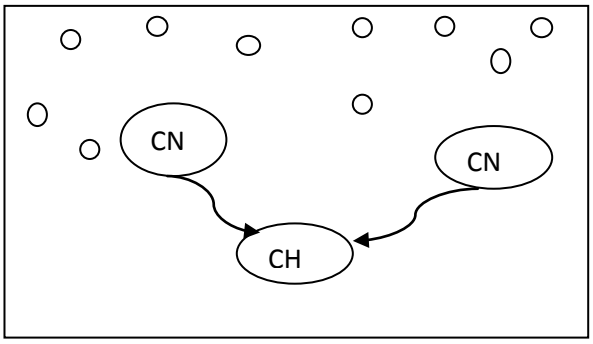

Figure.5. Two CNs send aggregated data to CH

1) Flowchart: The below flowchart explains steps to follow to reduce energy consumption while transmitting or receiving data. Nodes which are not being used in the network frequently can be sent to sleep mode till required by the network. Nodes which are used frequently can remain in active mode or sent to ready mode as per requirement. Nodes which have data to sent request for a time slot for sending data. Only the allotted node will transfer the data and no other node will be allotted the same time slot. Other nodes will be assigned different time slots. The flowchart explains when the nodes can be sent to sleep mode or ready mode as the requirement of the network. So the nodes which are not in work are either sent to sleep mode or ready modes for saving energy. This reduces energy consumption by the nodes and helps to increase nodes lifetime.

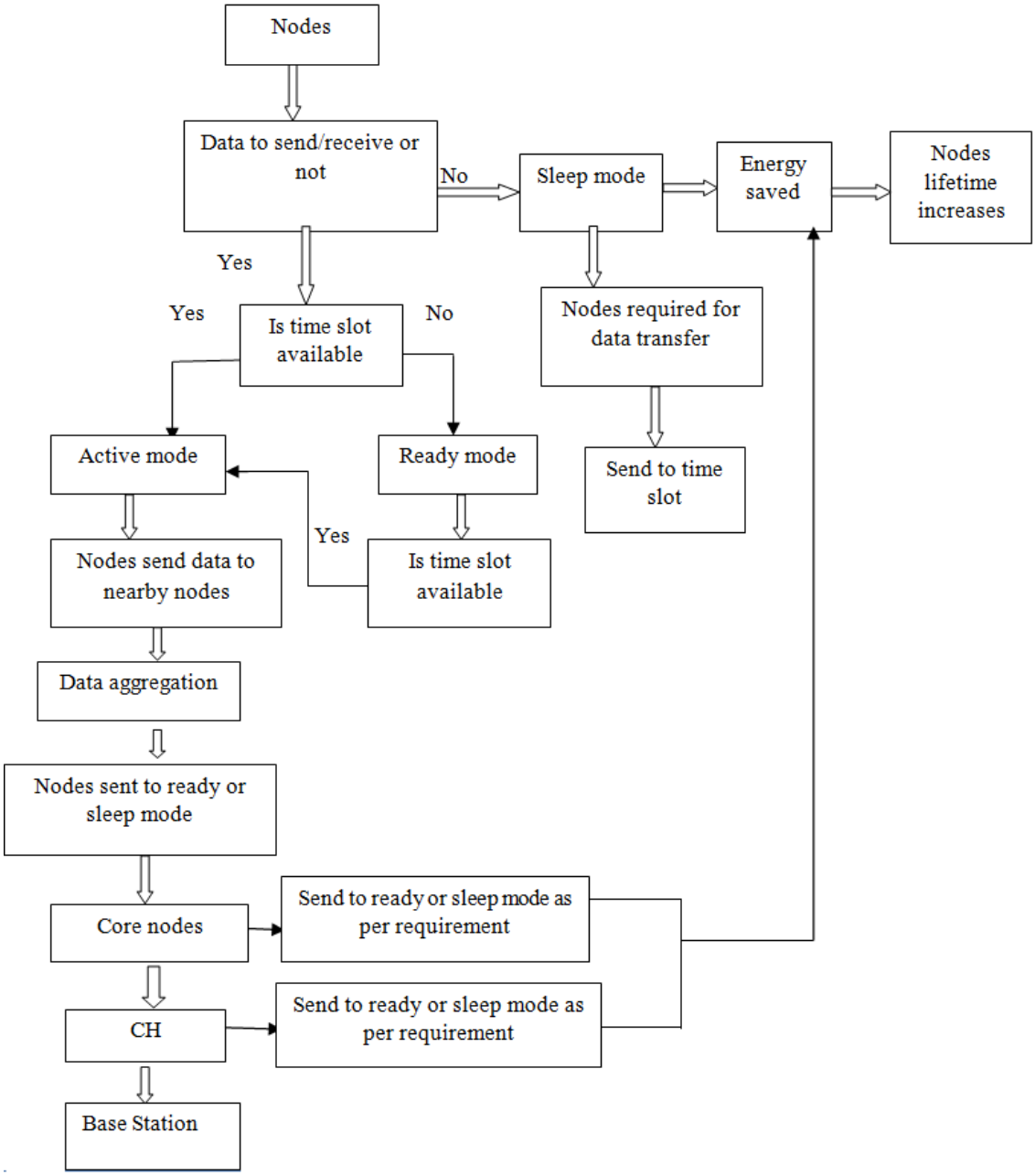

Figure 6. Flowchart showing minimum energy consumption by nodes thus increasing nodes lifetime

IV. NETLOGO

Using this software I have tried to show nodes behavior while gaining energy and losing energy. Nodes when acquire energy reproduce and hatch more nodes but when it loses energy it dies or goes to sleep mode.

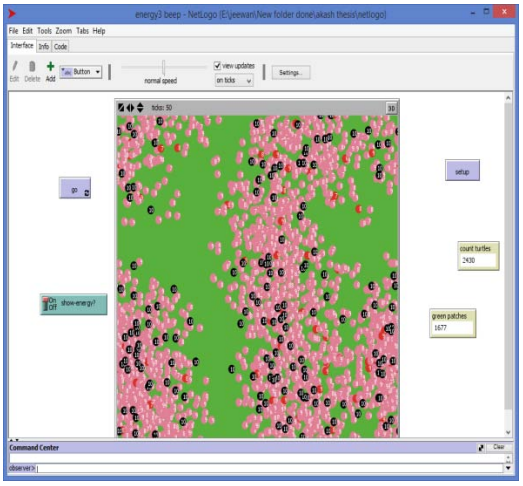

Figure.7. Diagram showing nodes behavior

Through this software I have shown how that nodes having energy less than or equal to one then it goes to sleep mode. But when energy is less than or equal to zero that node dies. Also if certain nodes have energy more than nine then it will hatch one node and assign energy to it.

Logic of coding used

```
to send-sleep
  ask turtles [
    if energy <= 1 [ beep
      repeat 3 [beep]

set energy energy + 10

    ]
to reproduce
  ask turtles [
    if energy > 9 [ set color black
      set energy energy - 10
      hatch 1 [ set energy 10 ]

    ]
  ]
end
```

V. CONCLUSION

It is concluded that for minimal energy consumption in intelligent greenhouse, aggregation of data need to take place by following the concept described above. Multi-hop concept used in LEACH reduces energy consumption by the nodes. Core nodes could be one or more depending on the number of nodes present in the cluster. NetLogo shows nodes behavior when it has energy varying from <= 0 to > 0.

VI. ACKNOWLEDGMENT

I heartily express my appreciation and immense gratitude to supervisor Mr. Rashid Hussain, Department of Electronics and Communication Engineering, Gyan Vihar School of Engineering and Technology, Suresh Gyan Vihar University, Jaipur, for his valuable guidance, inspiration, and unconditional support without which this thesis would have been a dream.

VII. REFERENCES

[1] Saman Toofani and Abolfazl Toroghi Haghighat, "Energy efficient static clustering algorithm for maximizing continues working time of Wireless Sensor Networks," ACSIJ Advances in Computer Science: an International Journal, Vol. 4, Issue 1, No.13, January 2015 ISSN : 2322-5157.

[2] Zouhair A.Sadouq, Marouane El Mabrouk and Mohamed Essaaidi, "Conserving Energy in WSN through Clustering and Power Control," 978-1-4799-5979-2/14 2014 IEEE.

[3] Sulakhe Vinayak V and Dr. Mrs. S.D. Apte, "Real Time Monitoring of Agri-Parameters using WSN for Precision Agriculture," International Journal of Advanced Research in Computer Science and Software Engineering 3(9), September - 2013, pp. 1045-1048.

[4] Rashid Hussain, J L Sahgal, Purvi Mishra and Babita Sharma, "Application of WSN in Rural Development Agriculture Water Management," International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-2, Issue-5, November 2012.

[5] Ibrahim Mat, Mohamed Rawidean, Mohd Kassim and Ahmad Nizar Harun, "Precision Irrigation performance measurement using Wireless Sensor Network," ICUFN 2014, 978-1-4799-3494-2/14 IEEE.

[6] Sujit P. Jagtap and Dr. S. D. Shelke, "Wireless Automatic Irrigation system based on WSN and GSM," IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 9, Issue 6, Ver. III (Nov - Dec. 2014), PP 13-17.

[7] Miroslav Babiš and Peter Magula, "NetLogo – an alternative way of simulating mobile ad hoc networks," 978-1-4673-2994-1/12, 2012 IEEE.

[8] Komal Batool, Muaz A. Niazi, and Sarmad Sadik, "Towards modeling complex Wireless Sensor Networks using Agents and Networks: A systematic approach," 978-1-4799-4075-2/14, 2014 IEEE.