International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Design and Implementation of Intelligent Network With Ultra Low Power Controller

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Abstract: ***Wireless Sensor Network is adhoc type network which performs it's all tasks in very small sizes and less power so that there is need to improve the performance of the network. Here network load, packet loss and communication cost is taken into consideration and its impact is shown on the performance of AODV and modified AODV routing protocol. In this paper AODV and M-AODV protocol is elaborated by Network Coding in NS2. As MSP430 Sensor Nodes communicate between them with this M-AODV protocol these nodes interfaced with CC2500 serial transreceiver wireless module in line of sight communication for fast communication between nodes.***

Keywords: wireless sensor network, NS-2, ultra low power, serial transreceiver module

1. Introduction

MANET [1] is set of sensor nodes that can form network to transfer information without use of fixed infrastructure network. The specialty feature of MANET moves this technology with big opportunity and several challenges. They are classified as table driven, on-demand and hybrid routing protocols.

As AODV is reactive routing protocol [1-3]. The important advantage is on-demand route is created and use of sequence number to built fresh and loop free routes. This protocol is good for small networks. M-AODV protocol performance is getting changed, in NS2 simulation criteria packet loss is reduced, load on network is increased, and lastly communication cost is minimized as compared to AODV.

AODV and other on demand protocols use single old route entry for each source to destination paths, here route table and single uniform route reply packet [4-9] along the reverse path. The modified version of AODV called as M-AODV [9]. Here in AODV protocol RREP message packet changed drastically so the loss of one packet of RREP increases the delivery ratio communication delay and overhead of networks. So that R-AODV will broadcast the RREP packet throughout the network instead of single reverse path which provides source node and it has the chances of finding multiple routes for destination. Therefore it results in obtaining multiple routes and delivers data packets successfully, as data may be of different formats this digital data is sent to destination without loss of packets. In this paper analysis of AODV and M-AODV has been written on major three criteria's of network parameters. They are packet loss in network, network load and communication cost in the network.

2. Nature of Protocol

This session of paper concentrates on behavior of AODV and Modified AODV based on which analysis is carried out.

2.1 Adhoc Ondemand Distance Vector(AODV)

AODV is reactive and routing protocol uses old routing tables, one entry per destination and sequence numbers are used to determine whatever routing information is upto date and to prevent routing loops [1][3]. AODV is a destination initiated type of protocol that creates multi-hop routing between the sensor nodes in a adhoc network.

Its routing algorithm uses massage types for route discovery and route maintenance process. The AODV network is sailent until the connection is needed, at that point the network node that needs a connection broadcast. A request for connection called as Route Request (RREQ) packet to all its neighbors. These RREQ packets transferred in all direction in the network region till it reach to the required destination node or any intermediate node with fresh route (fresh route is the route with new sequence number) to the destination.

Table 1: Route Request Parameters

Source IP address	*Request ID*	*Source sequence number*	*Destination address*	*Destination sequence number*	*Hop count*

The route request ID and source IP address pair of RREQ packet will present from being repeatedly processed at any midpoint nodes [3]. The route reply packet (RREP) is sent back to source node via same path or reverse path.

Table 2: Route Reply Parameters

Source IP address	*Destination address*	*Destination sequence number*	*Hop count*	*Life time*

Route reply is sent to the source node form destination node. Route Error message (RERR), here the link to any intermediate node is not valid for long time, at that time it initiates a route error packet and broadcast it to the neighbor nodes (RERR) this process is repeatedly carried out until the RERR message will reaches to the source node. After receiving this packet the source node will check for new routes in routing table otherwise it initiates the route discovery process after all the establishment of route the

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source node broadcast HELLO message to all the neighbors for activation of link.

A. Modified-AODV

We are modifying AODV protocol for considering communication cost, network load, and packet loss in network. To achieve this the network coding technique is used. Cost of communication will be obtained by finding Euclidean distance between the nodes. It is calculated and it gives time for sending data from source to destination. Hence Euclidean distance formula used for calculating cost of network in time limit. Consider figure 2 here source 1(p1,p2) is its coordinates and destination 5(q1,q2) of source and destination. We want to find distance between 1-5 nodes then its distance formula is as follows [4].

$$D = \sqrt{(p1-q1) + (p2-q2)}$$

Hence the overall distance[5] is obtained from source to destination. This is another network coding method. The performance of normal ADOV and modified AODV is compared, and modified AODV[6] observed the good results.

- Cost of communication: depend on no of nodes utilized.
- Network load: total traffic received by network layer (bits/sec) while transmission.
- Packet loss: depend on no of packets lost in transmission.

3. Simulation and its Results

Simulation has been done for 5 nodes using NS 2 simulator software in the area of size 40 meter X40 meter, the performance criteria packet drop, network load and communication cost. These are run for both normal AODV[11] and Modified AODV protocol[12]. The red colour in figure represents Normal AODV, while green colour represents Modified AODV.

Simulation characteristics
No of nodes: 05
Routing Protocol: AODV
Traffic Source: CBR
Area: 40*40meter
Mac type: IEEE802.11
Simulation: NS2

In figure 1 no of data transfer plotted with cost

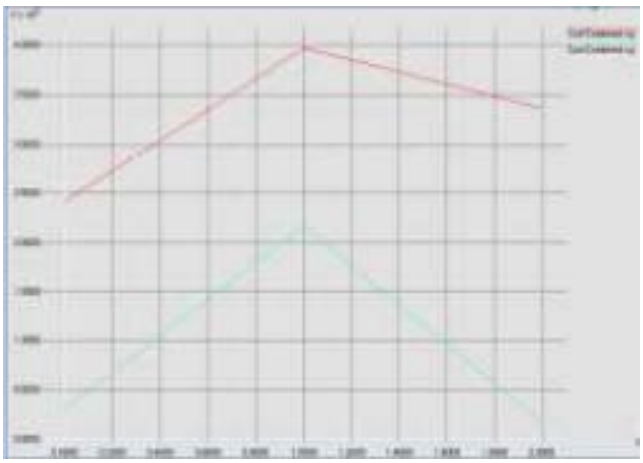

Figure 1: Graph of Number of Data Transfer vs Cost

The graph shows the cost of Normal AODV is higher than modified AODV. Hence it is decreasing cost observed in the graph.

Figure 2: Number of Data Transfer VS Packet Loss

Number of data transfer is plotted against the packet loss. Hence M-AODV has low packet loss as compared to normal AODV protocol.

Figure 3: Number of Data Transfer VS Network Load

This figure shows the graph between number of data transfers and network load. We find that MAODV has very less network load than normal AODV protocol.

4. Implementation

4.1 Hardware Consideration

As here sensor node is made up of MSP430 IC, we are using MSP-EXP430-G2 Launch Pad evaluation kit for making node. As here temperature and light is sensed on each node, here 5 sensor nodes are made from MSP430 IC. And continuous monitoring of environment is done, in sensing light and temperature. Each node is intercommunicated between each other by CC2500 wireless module and the operating system of these nodes is on computer. Here some features of each node

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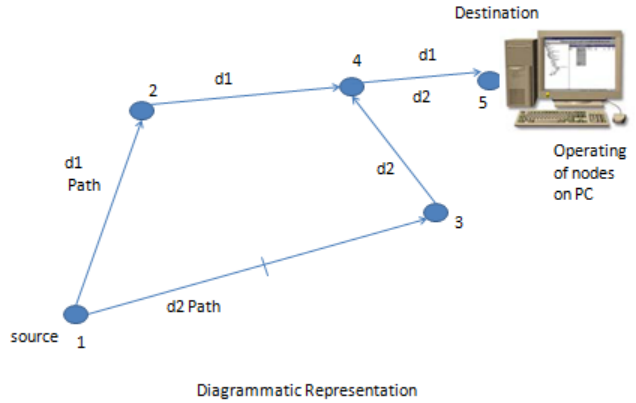

Figure 4: Diagrammatic Representation

This is application based project so that long life of each sensor node is taken in to consideration. MSP430G2553[8] is low power 16 bit microcontroller with an 8 channel 10 bit ADC on chip comparator, touch sense enabled i/os, universal serial communication interface 16 KB flash memory and 512 bytes of RAM. This 16KB flash memory is sufficient for programming of node. The temperature and light sensor are connected to the ADC and only two channels are used.

B. Design Parameters

Mode of communication: Wireless
Protocol to be worked on: AODV
Simulation Software: NS2[10]
Sensors interfaced with each node: temperature and light
Number of nodes: 5 (1+4)
Master slave node: 1
Communication Standards: ISM band 2.4 GHz
Supply voltage: 5V-9V
Range of communication: 40metres (LOS)
ADC channels: 6
Module: CC2500 transreceiver module
Evaluation Kit: MSP-EXP430-G2
IC: MSP430G2553
Operating System: run on XP/Windows 7
Technique for modifying algorithm in NS2: Network coding

C. Node Archetechture

Here each node is introduced with light and temperature sensor it includes the sensors/transducers in this light sensor (photodiode) and temperature sensor RTD is interfaced, there are different sections such as sensing unit, Processing Unit, Communication Unit, power section all these are mounted on PCB. Here power to all units is obtained from batteries 9V supply. Processing unit made of ultra low power IC MSP430G2553. Communication unit made of CC2500 transreceiver module.

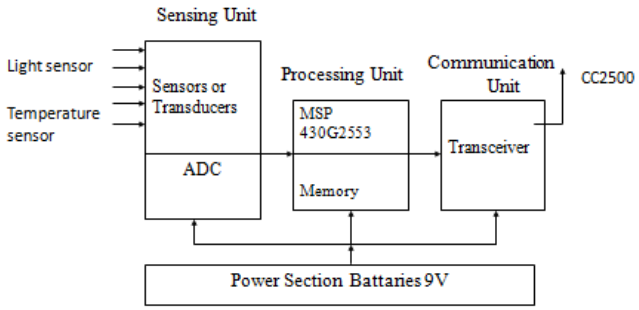

Figure 5: Sensor Node Architecture

Control of the components of sensor node is in hand of msp controller and all its computations. Power to the all devices is taken form 9V battaries so that power consumption of this each node at instant of high data transfer is 0.025mW or maximum current consumption is 21microAmps. Hence life for each node is minimum of 7 years, and intelligence of the protocol is added into programming of IC.

D. Communication of Nodes

As the node communication becomes successful by CC2500 Serial Transreceiver [9] Wireless Module. This is LOS device so that its range is up to 40 meters and it has 6 ADC channels with 8 bit precision. This project is limited to 5 nodes out of which one node is connected to PC for operating of these nodes, and 4 nodes are kept at a distance in communication occurs between them. This operates at 9600 baud rate.

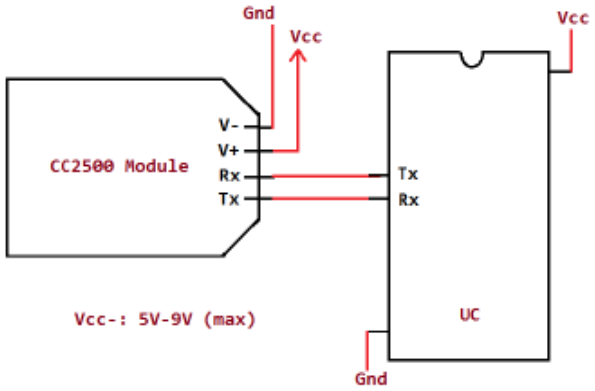

Figure 6: Interfacing of CC2500 with microcontroller

This CC2500 transreceiver module [9] is can be configured to microcontroller. This is fast process for interfacing. There are some steps for interfacing.

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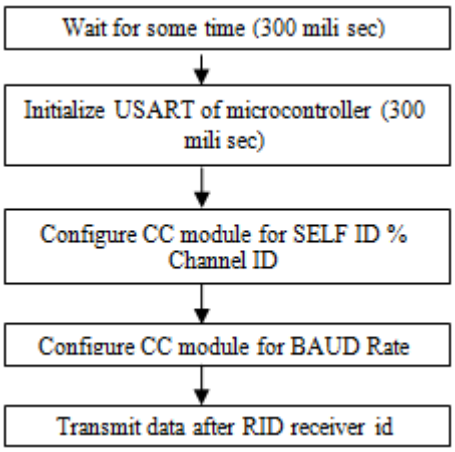

Figure 7: Flowchart for Communication in CC2500

This module is used for fast communication between the nodes as the wake up time for controller is 10 microsec.

E. Circuit Diagram

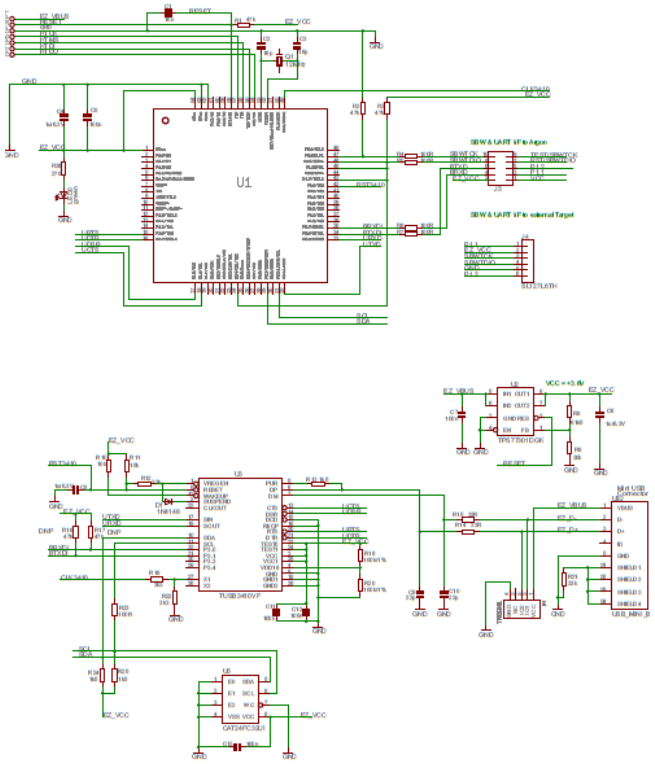

Figure 8: Circuit Diagram of Node

F. Signal Conditioning

As the signal conditioning section includes the obtaining signal from transducers and convert these signals into electrical signals so that these are readable to ADC of microcontroller hence microcontroller will process that data as per programming send it to the near by node as per destination address provided in the request. Signal of photodiode is in millivolts so that these signals are given to instrumentation amplifier at this level signal amplified 10 times and then transferred to ADC of microcontroller. Signal from RTD is in millivolts so that these signal given amplifier so that we can amplifiy to 10 times as emitter coupled amplifier is implied on it.

G. Programming

The programming done in embedded c language so that microcontroller will understand it. We used code composer studio (CCS v 4) by clicking file and import it. And IDE used for writing the program is IAR Embedded Workbench (Kickstart IDE). Program size is 12 kb so that it is easily saved into the microcontroller.

5. Operating System

Here operating system for these nodes is controlled on any laptop or PC which have minimum criteria of P4 processor and RAM 256MB, having storage capacity of minimum 10 GB free space. Hence this operating system will be user friendly. We can easily monitor the environment by this operating system. We have temperature and light monitoring on the screen of PC. Temperature will be displayed in degree Celsius and light will be counted in illuminecence/cm so that the count will be very helpful for monitoring purpose

6. Discussion and Future Work

This paper will introduce regarding the protocol nature and implementation of the modified AODV protocol into sensor node. For our consideration we considered 5 nodes but when it is implemented on large scale, this will be very useful for the environment monitoring, airport monitoring, structural monitoring, agricultural monitoring, forest fire monitoring, weather report monitoring[7] etc. as the communication is LOS based then power loss is minimized so that there are some limitations in the radio communication, when there is no need of LOS then the loss in the communication then we can move these nodes on different locations, hence mobility criteria is taken in to consideration.

References

[1] Elizabeth M. Royer, Chai-Keong Toh, "A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks", IEEE Personal Communications, Vol. 6, No. 2, pp. 46-55, April 1999.
[2] S.R. Das, R. Castaneda, J. Yan, and R. Sengupta, ―Comparative performance evaluation of routing protocols for mobile, ad hoc performance evaluation of routing protocols for mobile, ad hoc networks,‖ 7th Int. Conf. on Computer Communications and Networks (IC3N), pages 153–161, October 1998.
[3] "Ad hoc On-Demand Distance Vector (AODV) Routing", available at URL: http://www.ietf.org/rfc/rfc3561.txt.
[4] Thanthry N, Kaki S. R. Pendse R.,"EM-AODV metric based enhancement to aodv routing protocol" IEEE 64th Vehicular Technology Conference pp.1-5,2006
[5] M. K. Marina and S. R. Das ―On-Demand Multi Path Distance Vector Routing in Ad Hoc Networks,‖ Proc. ICNP 2001, pp. 14– 23 Nov. 2001
[6] A. Nasipuri, R. Castaneda, and S. R. Das, ―Performance of Multipath Routing for On-Demand Protocols in Mobile Ad Hoc Networks,‖ Mobile

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Networks and Applications, vol. 6, no. 4, pp. 339–349, Aug. 2001.
[7] N. Xu, “Survey of Sensor Networks and Applications” http://eln.usc.edu/ningxu/papers/survey.pdf
[8] The texas instruments, “available at URL: http://microcontroller.ti.com/downloads/slu318E.pdf
[9] The Serial Transreciver Module ,”CC2500 available at http://wegarobokit.com/wirelessmodule/cc2500.pdf
[10] Rua Yang; Zhi-yuan Li, "A stablity routing protocols base on Reverse AODV," Computer Science and Network Technology (ICCSNT), 2011 International Conference on , vol.4, no. pp.2419,2423, 24-26 Dec. 2011
[11] Pravanjan Das and Upena D Dalal, “A Comparative Analysis of AODV and R-AODV Routing Protocols in MANETS” Internaltional Journal of Computer Applications 72(21):1-5, June 2013 Published by Foundation of Computer Science, New York, USA.
[12] “The Network Simulator” NS-2, Available at URL: http://www.isi.edu/nsnam/ns, 2004

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