



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].

$$D = \sqrt{(p1-q1)^2 + (p2-q2)^2}$$

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.

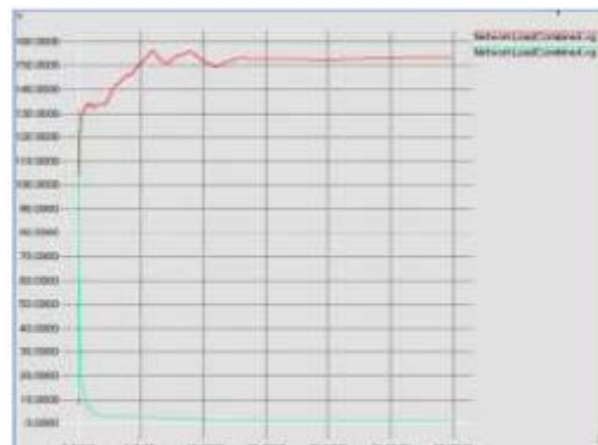


Figure 3: Number of Data Transfer VS Network Load

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

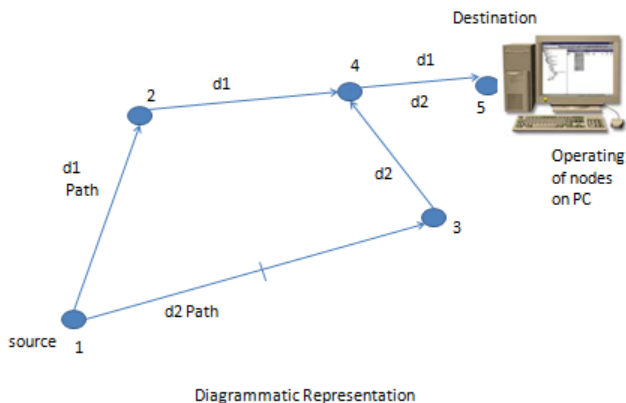


Figure 4: Diagrammatic Representation

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 transceiver 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 transceiver module.

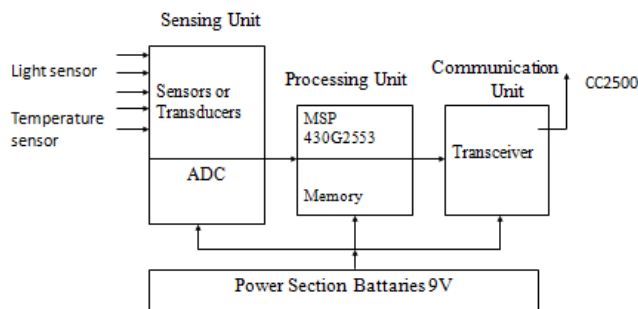


Figure 5: Sensor Node Architecture

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 batteries 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 Transceiver [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.

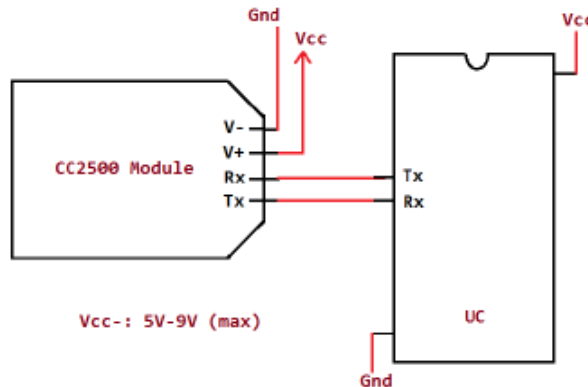


Figure 6: Interfacing of CC2500 with microcontroller

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

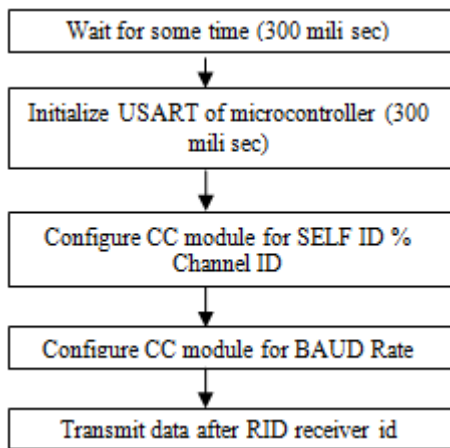


Figure 7: Flowchart for Communication in CC2500

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

**E. Circuit Diagram**

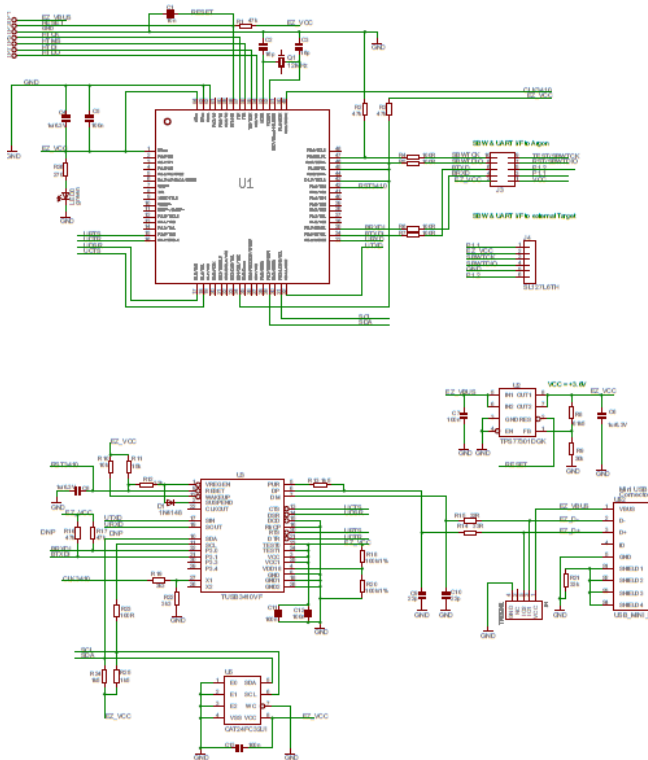


Figure 8: Circuit Diagram of Node

**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.

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