Energy Efficient & Optimum Path Selective Techniques For Flood Monitor System In WSN

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Abstract

Natural disasters such as , flooding earthquakes results in massive loss of life and property .To optimize loss due to such natural disasters Warning communities of the incoming disaster provides an effective solution to this by giving people sufficient time to evacuate and protect their property. The aim of project is to design the event driven Flood Monitoring System with wireless sensor networks. This system Measures River and weather conditions through wireless sensor nodes equipped with different sensors. An event driven system support multirate sampling . To design system we selected CC2530ZNP mini kit as hardware platform. It is ZigBee network processor which is based upon MSP430F2274 controller; this kit has battery operated sensor node with low power consumption & event driven system gives energy efficiency in node We simulated the routing metric which is designed to find path efficiency between single hop transmissions as well as for multiple path efficiency calculation. The routing metric is designed considering residual energy of each node and required delay The routing metric consider connectivity between nodes and retransmission of data; hence guaranteed transmission of data from source to destination is assured with minimum energy path utilization this increases lifetime of the network.

***Keywords*—** wireless sensor network, Event driven, rain fall sensor, CC2530ZNP, MSP430F2274.

I. Introduction

This project is aimed at helping the population large amounts of property loss and casualties caused by flash-floods. A flash-flood is a sudden discharge of large amounts of water. Usually, heavy rainfall increases the level of rivers; at the same time, a dam-forming effect occurs, triggered by other phenomena like ice jams or landslides. The aim of this paper is to describe the design and implementation of a system that will collect the environmental data like rain fall, weather condition & water level with least human monitoring.

An important aspect of flood management is the issuing of timely flood alerts. The spatial, as well as temporal, scale of these warnings is important. Such situations include issuing warnings for small groups of outlying houses or key infrastructure locations such as power sub-stations

In a Rainy climate, the water level rise to high level due to heavy rain and it is normal level due to sunshine throughout the year. In a conventional flood monitoring system the sensor data would be collected on constant rate throughout its operation period.

This approach monitor data rate constantly which gives huge data which is constant & does not show change occurred in envir onmental condition so better approach is to develop a system which is shown in fig 1 support for change in data sampling rate according environment condition. The main aim behind this project is expand functionality of wireless sensor network which continuously monitor parameter like rain fall, weather condition & water level.

1. System development

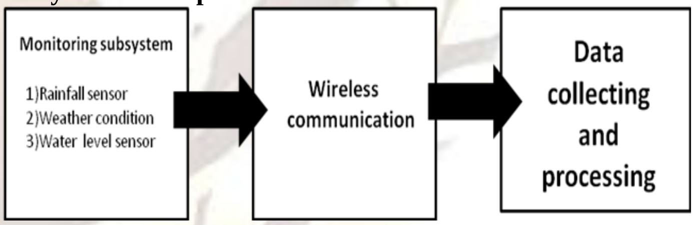

Fig 1 Block Diagram for flood Alert Monitor system.

Monitoring subsystem:-

In this project various parameter like water level, light intensity, battery voltage (node battery) are monitored & system is designed with multirate sampling. In normal days when water level at normal level (below the position of sensor 1), node of slaves send data with low sampling rate & when event of flood occur node send data with high data sampling to coordinator.

Wireless communication:-

Communication between slaves & coordinator is wireless ZigBee module of CC2530ZNP kit is used for wireless communication purpose.

Data collecting & Processing:-

Reading of different sensor of each node is send to coordinator & which is updated at GUI. GUI gives status of all sensor of all slaves or nodes which is designed at coordinator side.

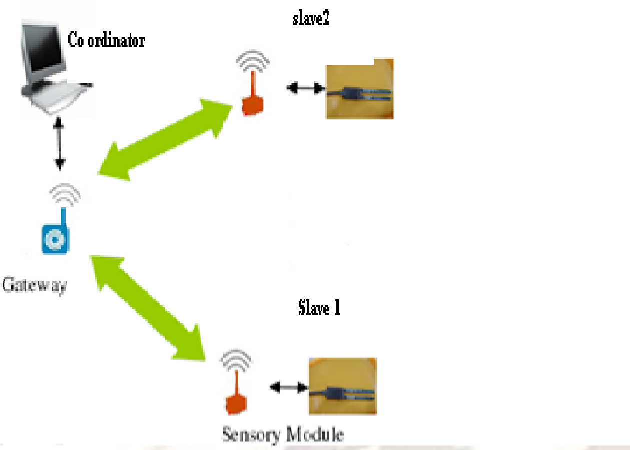

Fig 2 system Deployment

In Flood monitor system the implementation of Wireless sensor network with low power consuming node is interfaced with Sensor which monitoring environmental parameter is shown in fig 2. Selected CC2530ZNP node is low power consuming which itself has ZigBee architecture. The given slaves (slave1 & slave2) monitor parameter regularly with different sampling rate as per occurrence of event. In a WSN, every node acts as a data acquisition device, a data router, and a data aggregator. Such architecture maximizes the redundancy and consequently, the reliability of the entire flash-flood monitoring system.

2. Event driven motes

To design event driven system we selected CC2530ZNP as mote which shown in fig 3 & Magnetic Reed Liquid Level Sensor which shown in fig 4. Mote itself consists of light intensity sensor. The hardware consists of a CC2530 ZigBee device preprogrammed with ZigBee software and an MSP430F2274 microcontroller that controls the ZigBee device.

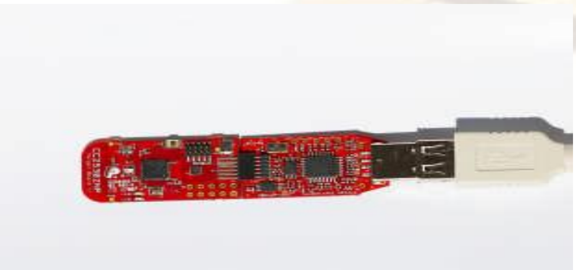

Fig 3 CC2530ZNP mote

Advanced Features of CC2530ZNP:-

- The network processor is a SW image on the CC2530 device, allows upgrade to future ZigBee extensions.
- The source code for the network processor is provided as a sample code in the Z-Stack software package .
- The network processor code is flexible to allow support of custom configurations.
- Support for both non-secure and secure ZigBee communication.
- Small 6x6mm package .

Fig 4 Magnetic Reed Liquid Level Sensors

In magnetic reed liquid sensors When the float ball rises or falls with the liquid to the level of the switch, the magnetic force of magnet which inside of the float ball will cause the reed switch to turn ON. When the float ball move away from the reed switch, the reed switch will turn OFF.

3 .Low power mode architecture

In event triggered, multirate sampling flood monitoring system for designing low sampling architecture we are using low power mode 3 (LPM3) of MSP430F2274 microcontroller. Architecture of LPM is shown in fig 5. This LPM3 minimize power consumption of mote, increase energy efficiency of node & increase life time of node.

Configuration of LPM3 is given by,

(LPM3), I ≈ 1uA
a. CPU is disabled
b. MCLK and SMCLK disabled
c. ACLK remains active
d. DCO's dc-generator is disabled

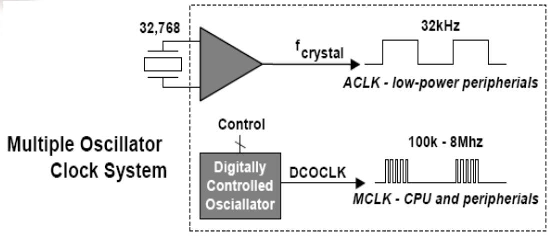

Fig 5 Low power architecture of MSP430F2274

4. Flow charts of flood monitor system

Proposed flood monitor system consists of two slaves (slave1 & slave2) & coordinator which are shown in fig 2. Flow chart which is shown in fig 6 gives detailed working flow of slaves & Flow chart which is shown in fig 7 gives detailed working flow of coordinator.

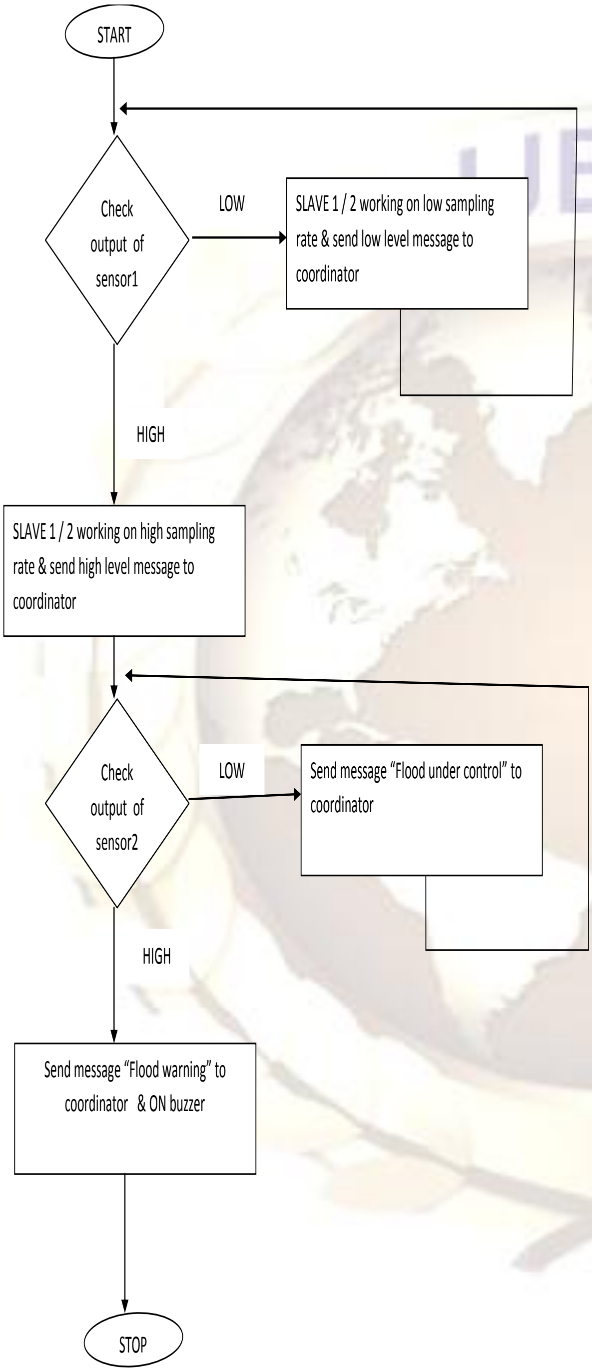

Fig 6 Flow chart for slave1 & slave2

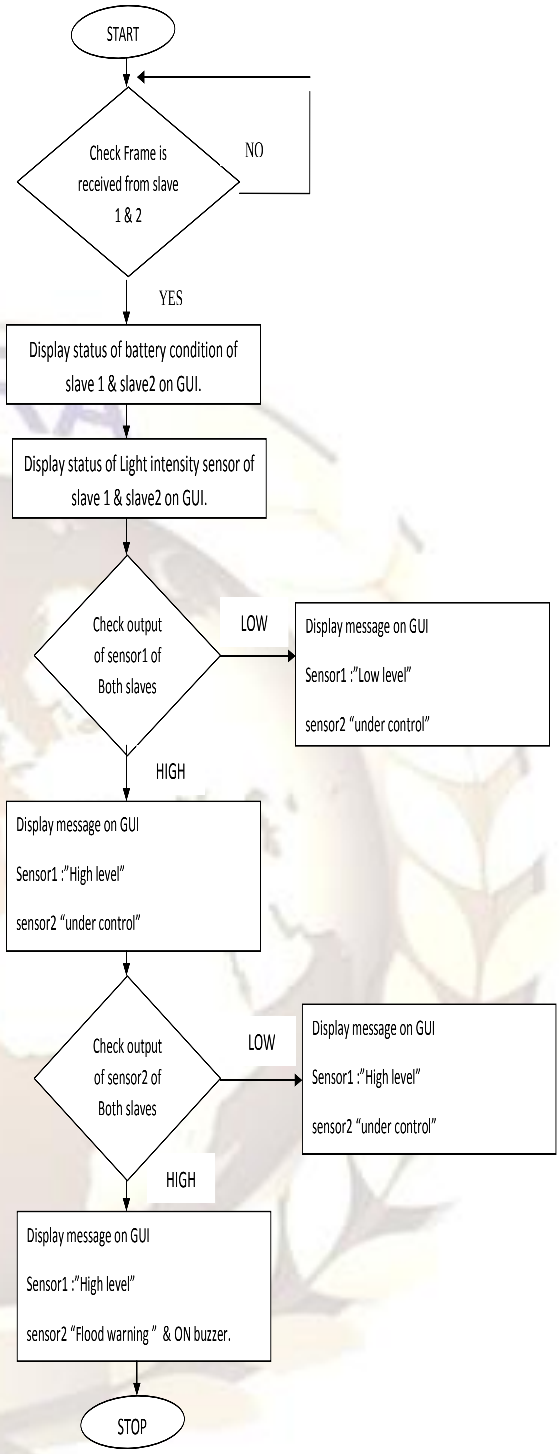

Fig 7 Flow chart for coordinator

5. Routing Matrix Model for simulation of optimum Path

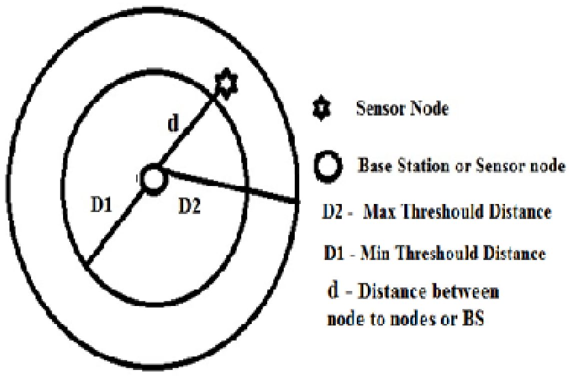

Fig 8 Routing Matrix Model

For optimum path purpose, We adopt the model shown in fig 8. This model captures the packet reception rate (PRR) between two nodes as follows. Nodes have full connectivity if they have a distance less than *D1*. They are disconnected if they are separated by a distance greater than *D2*. The expected PRR decreases smoothly in the transitive region between *D1* and *D2*. The behaviour is modelled by equ (1)s

$$PRR = \begin{cases} 1 & d < D_1 \\ \left[\dfrac{D_2 - d}{D_2 - D_1} + X \right]_0^1 & D_1 \le d \le D_2 \\ 0 & d > D_2 \end{cases} \quad (1)$$

Where X ~ N(0, σ^2) is a gaussian variable with variance σ^2.

(This equation is modified, in numerator, d – D1 is replaced by D2 – d to find 1 when d = D1)

5.1 Proposed Solution for optimum path

The proposed approach consists of following steps

Phase-I: Cluster head selection and cluster formation

Step I: Base Station based First Cluster Head Selection:

All the deployed nodes send their energy levels to the Base Station. Then on the basis of energy level and delay path efficiency is calculated between each node and BS. Node with high path efficiency and at distance less than d2 is selected as cluster head.

Step II: Cluster Formation

After First cluster head selection the cluster formation phase starts. Path efficiency between neighbor node and cluster head is calculated. If Neighbor's path efficiency is greater with cluster head then associate each node as CM of cluster with CH.

Step III: Base station based Selection Of Another Cluster Head

Now consider another node not included in previously formed cluster and again find a node with high path efficiency and at distance less than d2 consider the node as another CH after selection of CH form cluster by step II Continue this step until all nodes at distance d2 are selected in clusters formed

Step IV: CH Based Cluster Head Selection

Consider any Previous selected CH set Now calculate path efficiency between each node and CH. Node with high path efficiency and at distance less than rc is selected as cluster head

Step V: CH Based Cluster formation

After cluster head selection the cluster formationphase starts. Path efficiency between neighbor nodeand cluster head is calculated. If Neighbour's pathefficiency is greater with cluster head then associateeach node as CM of cluster with CH.

Step VI: Repeat Step IV and V to form cluster until each node is associated with a cluster. Result of optimum path algorithm shown in fig 12 & fig 13

6. Result:-

In this paper we are discussing result in two section ; one for flood monitor system & another is simulation result for optimum path algorithm

6.1 Result for Flood monitoring system

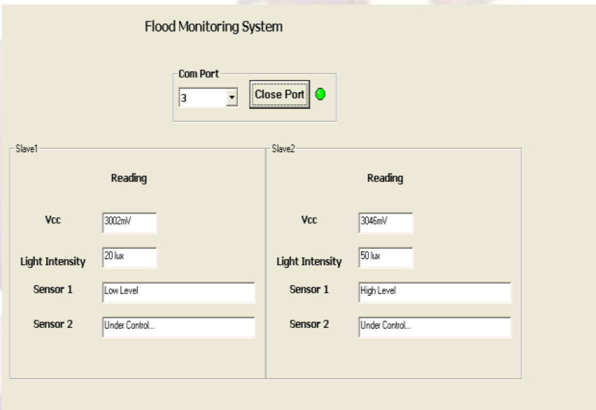

Fig 9 GUI of Flood monitoring system

Flood monitoring system monitoring parameter water level of Dam, light intensity of surrounding of Dam & voltage of node. In given system we are monitoring parameter of two Dam which are on same river

Dam1 reading (slave 1) :- It monitor water level & light intensity of surrounding. Sensor 1 kept at position which sense 55% of height of dam from its base . It sense water level which is less than its level level of flood is low & low level massage is send to co coordinator .

In this " low level" position sampling rate of node is low because node goes in low power mode (LPM3) It send data after every 45 second to coordinator . In this mode node consume 3.5mA current which is shown in fig 10.

Fig10 Current consumption of node during absent of flood (Low sampling rate)

When flood occur & water level rise above 55% then "high level " message is send by sensor node to coordinator in which controller of node wake up from LPM & comes into active mode & send data to coordinator after every 4 second In this mode node consume Current around 6.7mA .

Fig 11 Current consumption during occurrence of event Flood (High sampling rate)

Sensor 2 is kept above the sensor 1 which gives indication of actual situation of flood in normal case it send message flood "under control " & When flood level goes on increasing & it crosses 80 % of height sensor2 send message " flood warning " to coordinator & buzzer get on. Finally Node is also transmitting status of battery voltage which is shown in GUI for monitoring battery condition.

Dam2 reading (slave 2) :-

Slave 2 working as same as slave 1 .

So combining both reading (which is shown on GUI) one take decision that how many plates of dam should open for controlling flood & its cause .

6.2 Result of Optimum path algorithm:-

We have already discussed optimum path Algorithm in section 5; corresponding results are Shown below

6.2.1 Node deployment & PRR calculation

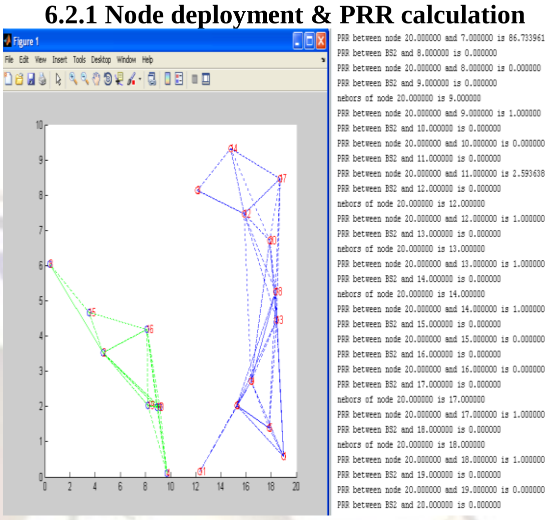

Fig 12 Deployment of node & PRR calculation

6.2.2Optimum path calculation between node 5&9

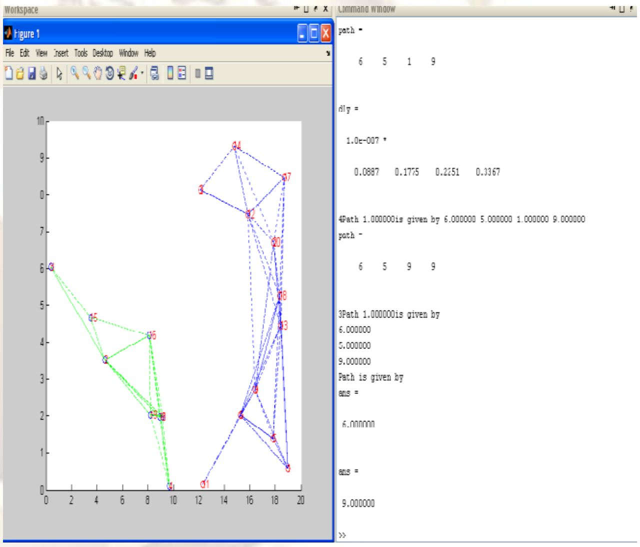

Fig 13Optimum path calculation between node5 &9

7 Conclusion

In this project we presented energy efficient flood monitoring system which monitoring parameter water level, light intensity and battery voltage of slave node . We have designed system such that nodes support multi rate sampling according to environmental condition & occurrence of event which gives energy efficiency in node. So due to this multisampling algorithm life time of node is getting around doubled.& further we simulated optimum path algorithm that considers residual energy of each individual node and selects energy efficient optimal path for data transmission

8 Future Work:

1. Test proposed optimum path algorithm for designed flood monitor system by increasing number of node in WSN.
2. Congestion control mechanism can improve existence flood monitor system performance.
3. This event driven system is designed for flood monitor is further implemented by using solar sensor node to increase life span of mote

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