Low Rate Wireless Sensor Network Green Computing for Flood Monitoring System

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Abstract

This paper presents the development of a low rate and low power consumption wireless sensor network. Wireless sensor networks are cheap and comprised of a small fully autonomous processing, communication and sensing devices. The purpose of this study is to develop the system for monitoring and flood warning. They will work with wireless sensor network (WSN) system. WSN has been restricted power supply, communication distance and low computing power. But they will work with network in vast area, send and receive raw data from each sensor node. It has the ability to cooperatively collect data and retransmit in order to process or alert. The first step of the experiment is creating main node and sub node in flooding area and finds transmission of data between them. When sensor node is not receiving or transmitting data, the module can be switched into the sleep mode, low power consumption mode.

Key words: Wireless sensor, monitoring and flood warning system, green computing.

1. Introduction

Components of Wireless Sensor Network (WSN) have sensor node (SN); and coordinator node or base station. Each sensor node is provided with a radio transceiver, a set of transducers for physical variable surrounding environment being measured, if it is sensor node and small processor unit. Each node is deployed in sensor field. They can perform themselves to ad hoc network, via wireless to communicate with each other, for collecting allocated data, and transfer them pass through base station for other processing. Some applications of Wireless Sensor Networks to optimal control of building energy systems, forest fire detector system in [1], home or building security system, military wireless sensor networks, or other fields those require wireless event-based sensors. Each node is small, low price, easy to deploy, and no network infrastructure are required. They can drop into dangerous or hazardous areas to monitor events of interested. The one of purpose design WSN is energy awareness.

In this paper, present development of low rate and low power consumption wireless sensor network, green computing for flood monitoring system. What is a low rate, it means low data transfer rate. Low data transfer rate uses lower power consumption than higher rate, low power for green computing, and node will work in the sensor area for a longer time. There are many techniques to design, an ultra-low power-aware design in [2]. A new modeling assumption for wireless sensor networks, that of node redeployment in [3]. In this paper uses wireless sensor device with IEEE 802.15.4 standard [4][5]. Follow with this standard, there are two physical device types: full function devices and reduced function devices.

2. IEEE 802.15.4 Standard Devices

IEEE 802.15.4 standard defines the property of Low Rate Wireless Personal Area Network (LRWPAN) into 2 Layers, Physical Layer and Medium Access Control Sub Layer (Fig.1). It has 2 support simple device types: Full Function Device (FFD) and Reduced Function Device (RFD). Standard FFD device will support fundamental physical and MAC 49 functions but RFD device will support only 38 functions. The devices can communicate to each other (Fig.2).

2.1 Full function device (FFD)

- Function in any topology
- Being the coordinator and PAN coordinator
- And can communicate with any other devices.

2.2 Reduced function device (RFD)

- Function only in star topology
- Cannot perform a network coordinator
- Communicate with its network coordinator
- Peer-to-peer communication.

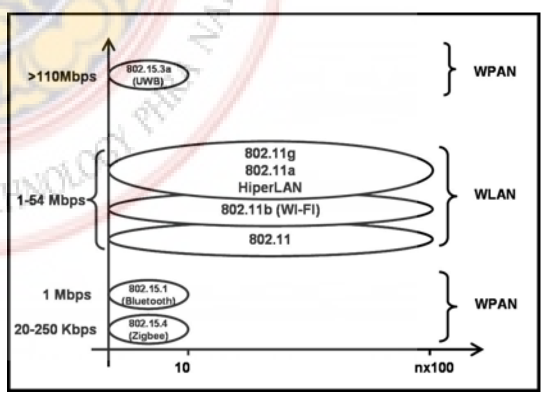

Fig.1 Technology of wireless network [4][5]

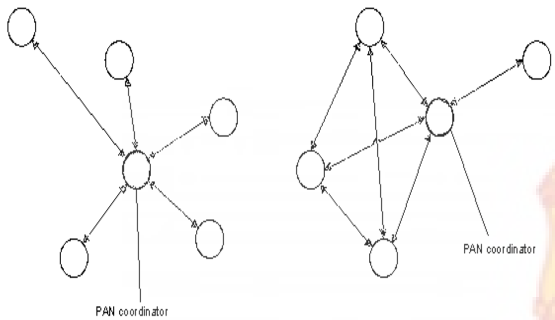

Fig.2 LRWPAN Network topology[6][7]

3. Architecture and system design

Fig.3 XBee Module [8]

Figure 3 is a used module in this experiment. From diagram in Figure 4, XBee 2 modules, one module is connected with microcontroller and the other work as sensor node. It can use standalone with sensor as sensor node.

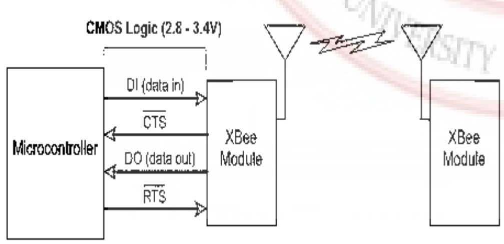

Fig.4 Data flow testing diagram [8]

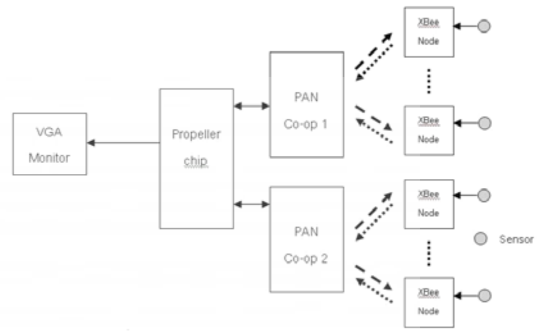

Fig.5 Block Diagram of the Experiment

From figure 5 shows connection diagram for microcontroller (in this test uses a propeller chip) and coordinator node via serial communication. We use signal pins, Dx for data in, Do for data out and use CTS, RTS for hardware flow control signal [9]. Figure 5-7 is experimental devices.

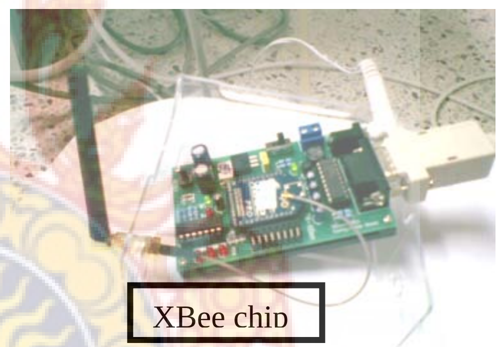

Fig.5 Coordinator node

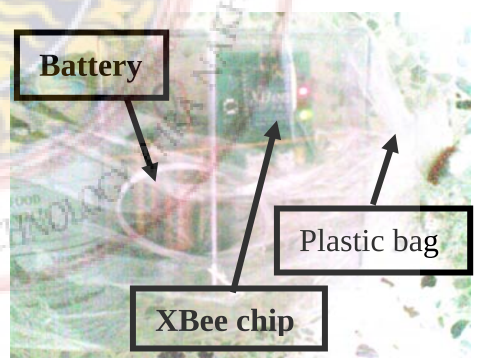

Fig.6 Sensor node (SN)

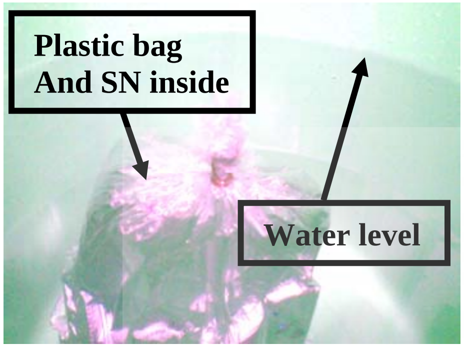

Fig.7 Sensor node in flooding testing area under water

In this application, the main processor is Propeller chip (microcontroller), and use Spin language [10] and Assembly language. From Figure 7 sensor node is wrapped with plastic bag for waterproof and loaded with weight.

The first step, experiment in testing area without flooding and change distance between main node and sensor node, data size is 10000 bytes.

Next step, experiment in testing area with flooding (sensor node is under water) and change distance, data size the same as above. By using Propeller chip, it can be connected with VGA monitor [10].

4. Experimental results and Discussion

Microcontroller, Propeller chip can communicate with XBee module and coordinator node receives data from sensor node. The simulation sends data from microcontroller to coordinator node via communication lines and coordinator node communicate via wireless to XBee sensor node. Data size is sent and receive with loopback at sensor node to coordinator node.

```
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGH
IJKLMNOPQRSTUVWXYZ[\]^_'abcdefghijklmnop
qrstuvwxyz{|}~!"#$%&
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGH
IJKLMNOPQRSTUVWXYZ[\]^_'abcdefghijklmnop
qrstuvwxyz{|}~!"#$%&
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Fig.8 Result Example of result

From figure 8 is a loopback dataset, 2 sets of 100 characters.

Table 1 Sent data and received data compared with node distance (%).

	1.0 m	1.5 m	2.0 m	20 m	25 m	30 m
No flood	100	100	100	100	90.7	86.5
Flood	100	61.2	33.6	-	-	-

From Table 1, when sensor node is flooded, communication data is dropped more than no flood sensor node.

The benefit of this experiment can be adapted to other researches. In the next experiment we will approve a new environment and transceiver.

5. Conclusion

From the experiment can use this information to develop flood monitoring system in small area, when it floods, the communication distance is decrease. But, this system is small node, cheap and can monitor without computer system (example personal computer). It is wireless network system, no wiring, low power consumption node. If the system uses Propeller chip, it can connect with LCD display rather than VGA monitor for energy saving. It, Propeller chip can be used with PS2 keyboard and can implement with mobile phone system for extending.

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