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Sensor Node Energy Consumption and Battery State-Of-Charge for WSN

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Abstract: *Data collection now-a-days has become one of the important factor to be looked upon. Data collection from a far place where a man cannot measure the parameters physically, there a data collection device is most suitable. To have this possible we are using a WSN network for data collection. A sensor interface device is essential for sensor data collection of industrial wireless sensor networks (WSN) in IoT environments. However, the current connect number, sampling rate, and signal types of sensors are generally restricted by the device. Meanwhile, in the Internet of Things (IoT) environment, each sensor connected to the device is required to write complicated and cumbersome data collection program code. In this project, to solve these problems, a new method is proposed to design a reconfigurable smart sensor interface for Radio frequency Identification in industrial WSN.*

1. INTRODUCTION

Wireless sensor networks (WSN), sometimes called wireless sensor and actuator networks (WSAN), are spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. Wireless Sensor Network Provides a bridge between the real physical and virtual worlds. In early 1970's the sensor networks were connected to each other via wires i.e. the sensors were wired. But now-a-days these wired networks are replaced by advanced Wireless Sensor Networks. WSN allows to observe the previously unobservable data at a fine resolutions over a large scale. They have wide range of potential applications to Industry, Science, Transportation, Civil infrastructure and Security.

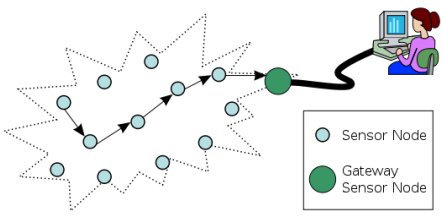

Fig 1: *Wireless Sensor Network*

The sensor networks would consist of Processor for processing the data sensed by sensor, Memory to store the data collected, an RFID to send and receive data and instructions respectively from the control center. Sensor node has a power supply which powers the circuit.

The origin of WSN was from military and heavy industries. Now-a-days WSN can be seen in light industrial and consumer applications as well. The first wireless sensor network was that was developed by USA to detect and track the soviet submarines. Systems emergence providing a modern approach for the design of various applications, namely, automotive, agriculture, structural health, etc. This solution permitted to offer an efficient monitoring as it established a geographically covered environment sensing. This network used submerged acoustic sensors hydrophones which are in use till today in atlantic and pacific oceans.

2. SYSTEM STRUCTURE AND WORKING PRINCIPLE

The Circuit Diagram tells that there are two slaves and one master controlling them. The slave is the sensor node which collects the data which is to be sent to the Master i.e. PC.

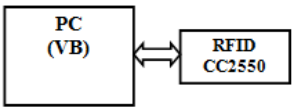

Fig 2: *Master (Personal Computer)*

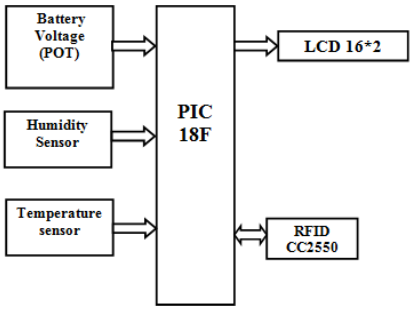

Fig 3: *Slave (Sensor Node)*

Sensor node has Temperature sensor, Humidity sensor and POT(Potentiometer) connected to it. These are the parameters that are to be controlled and monitored. The sensor node sends this collected data to the master by using RFID's. The Node sends the data if and only if the master demands it. PC is configured with an software to control the sensor nodes. For our simplicity we have considered only two sensor nodes but in practice we can have n number of sensor nodes.

First protocol used is to avoid data collision while communication. Request and Response protocol is used. In this protocol, the data is sent when the master calls or requests the sensor node(slave) to send the data. Each sensor node is given a slave id for identification. To show the status of communication between sensor node and PC, LCD is used. LCD is interfaced to PIC18F to display the process i.e. either data is transmitted or received.

The second protocol we are implementing in our project is Battery State-of-Charge. This protocol improves the battery life of sensor node. It in turn increases the network life of the network.

3. FLOWCHART OF PROTOCOLS

The proposed system uses two protocols, first the Request and Response Protocol. Request–response, or request–reply, is one of the basic methods computers use to communicate with each other, in which the first computer sends a request for some data and the second computer responds to the request. Usually, there is a series of such interchanges until the complete message is sent; browsing a web page is an example of request–response communication. Request–response can be seen as a telephone call, in which someone is called and they answer the call.

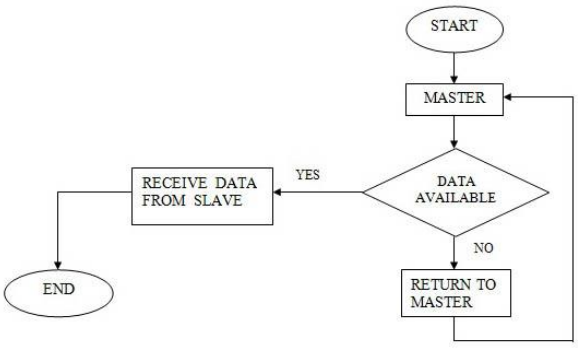

Fig 4: *Request and response Protocol*

Second protocol used is Data Collision Avoidance Protocol which is also called as modified request and response protocol. In the proposed system Data collision is avoided. Collision avoidance techniques are used in telecommunications and computer networks to avoid resource contention. These techniques attempt to eliminate situations in which multiple nodes access the same resource. This ensures that any node in a network can transmit a signal without colliding with other traffic on the network.

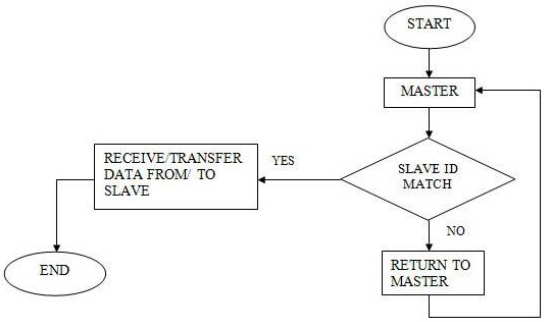

Fig 5: *Data Collision Avoidance Protocol*

Data collision occurs when two or more sensor nodes try to send data at the same time to one single master. To avoid these condition the sensor node(slave) are allotted a SLAVE-ID. The master requests the slave whether it possesses any data for transmission or not. If yes, then the data transmission will take place and if not the control is given to master so that it can communicate with another slave for data collection. As the master slave communication takes place using slave-id, so no two slaves will respond to the request at the same time.

4. RESULTS

Fig 6: *Master and Slave Connected*

The proposed system has two slaves. Slave 1 consists of Temperature sensor to sense the change in temperature of the surrounding. Humidity sensor to measure the change in humidity of the atmosphere. Potentiometer to sense the battery level. RFID is used to communicate between Slave 1 and Master. The main difference between Slave 1 and Slave 2 is that they are placed in different surroundings.

Slave 2 consists of Temperature sensor to sense the change in temperature of the surrounding. Humidity

sensor to measure the change in humidity of the atmosphere. Potentiometer to sense the battery level. RFID is used to communicate between Slave 2 and Master. Slave 2 has same components as that of slave 1 but the main difference between Slave 1 And Slave 2 is that they are placed in different surroundings. That means they will collect data of different surrounding atmospheres.

Personal Computer as Master is used to receive data from the Sensor Nodes (Slave 1 and Slave 2) and display the received data on Personal Computer. Visual Basics software is used to display the data using GUI. To process the data received from sensor nodes, RS232 is connected to match the logic levels.

When the battery voltage of the Sensor Node (Slave 1) is Full, it transmits data to Personal computer with less amount of delay. The Scan Time for Battery full condition is minimum. The Sensor Node (Slave 1) collects the temperature, humidity and senses the battery voltage and sends the collected data to master through RFID Module.

While Sensor Node (slave 2) is transmitting continuously to the Personal Computer (Master), there is degradation of battery. Suppose the battery level is 50% or below then sensor Node (Slave 2) will detect the battery level and if its below 50% then the Sensor Node (slave 2) will add some amount of delay in scan time of Sensor Node i.e., Slave 2. The delay in the Scan Time will save the battery life of Sensor Node.

We have collected data from two sensor nodes (slaves) and displayed it on Personal Computer (Master). As discussed earlier, after implementing two protocols namely Request and Response & Data Collision Avoidance the Energy consumption is achieved and data collision is avoided. It is verified from the result above that when the battery level of slave 1 in Full the Scan Time is less i.e., in milliseconds. When the battery level of slave is dropped below say 50% or less the scan time is delayed. Hence Battery Consumption at sensor nodes (slave) is achieved which in turn increases the Network Life of the system.

5. APPLICATIONS

The proposed system can be used for monitoring of physical parameters such as temperature, humidity, soil moisture, etc. For example it can find application in shrimp farming. The temperature of the ponds in which the shrimps are being kept should be maintained to a desired level. For this temperature of the pond should be sensed and monitored. Another application would be in agricultural farming. The soil moisture is an important parameter that should be monitored in order to get good yield.

6. ADVANTAGES

The advantages of the proposed system over previously used system are Low cost. Due to low cost of the system it can be used by all class of people. The second advantage over previous system is that it can detect and inform epilepsy accurately that means it can detect any sudden changes in the physical parameters in this case temperature and humidity so that corrective action must be taken. For communication with the user, system uses a user friendly GUI. This means that the data displayed by using a software in this case an Android GUI can be understood by user very easily. The proposed system has capability to work for 24 hours. This indicates robustness of the system.

7. CONCLUSION

Now-a-days data collection has become one of the important factor to be looked upon. Data collection from a far place where a man cannot measure the parameters physically, there a data collection device would be reliable. The device to achieve data collection should also be power efficient. In the proposed system by using data request and response protocol and Data Collision Avoidance protocol so the data collection can be achieved without data collision. Network life of the proposed system is increased as per the battery state of charge. The circuit of the proposed system is simulated using proteus software. The delay in the scan time increases the battery life. While the slave-id matching avoids data collision. Thus the result is verified.

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