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Wireless Sensor Network Implementation using MIWI Wireless Protocol Stack

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Abstract: This Paper is to design full functional nodes and to deploy wireless sensor network for Industrial parameter monitoring. Sensor nodes acquire the physical variable from field and wirelessly transmit to central master node for acquisition, monitoring, analysis and storage. The resulting designed product could form a reliable support for transferring data between nodes and a computer. A most important stage of this thesis work is to develop sensor nodes for collecting sensor data and acquires data on master node which has **MIWI** wireless protocol stack.

I. INTRODUCTION

Wireless Sensor Network (WSN) is a promising data mining solution of industrial wireless data network. Instrumented with wireless sensors, it will become available to monitor the plants in real time, such as air temperature, soil water content, and nutrition stress. The real time information of the fields will provide a solid base to adjust strategies at any time. WSN will revolutionize the data collection in industrial research. However, there have been few researches on the applications of WSN for industrial wireless network. This work was focused on the investigation of wireless sensor networks in industrial applications. The datasets were obtained from experiments. They could give an estimation of the sensors to be deployed in different environments given a certain area.

A. Modeling of Wireless Sensor Networks:

In that case, a model can be developed based on the following assumptions:

a. Initially, all the sensors have identical capabilities.
b. The sensors are anonymous: they lack unique identifier (e.g. addresses).
c. Several sensors can create a region (group): anonymity of a sensor in a sensor network dictates the creation of regions.
d. Each sensor belongs to exactly one region: the identity of this region is the only identifier available to the sensor.
e. A region has an address (coordinates) that uniquely identifies the region; no two regions can have the same address.
f. Communication among regions is based on addresses.
g. Sensor synchronization is short-lived and group-based, where a group is loosely defined as the collection of sensors that collaborate to achieve a given task.

II. WSN NETWORK MODEL

Wireless sensor Network consists of sensor nodes deployed spatially in the field and Coordinator node. Fig. 1.1 evaluates sensor nodes: Temperature, Pressure, Level and Humidity connected using star network topology considered for paper.

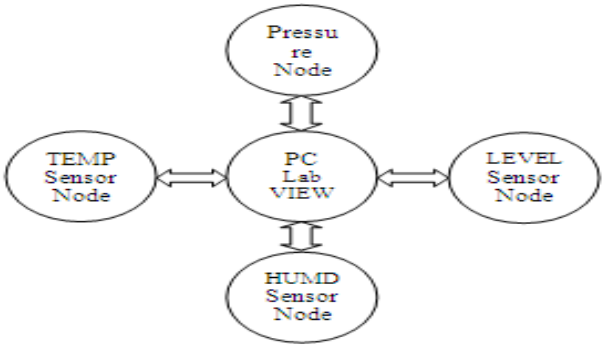

Figure.1. Wireless Sensor Network Model

A. Master & Slave Mote Design:

The design of this mote is not constrained by size and power limitations as this mote are to be located at the PC. The master mote is similar to the slave mote except it may or may not have a sensor. In the present work sensor has not been used on the master mote. But it is interfaced to the PC to facilitate the information display using LabVIEW.

The Slave mote design is similar to that of the Master mote except power requirement must be minimal as these motes are 'wireless units'. The Slave motes also require memory, as sensed parameter data's are stored before being sent at their respective time slots.

Microcontroller is used to run the protocol and interface to the wireless module; and a RF transceiver needed to transmit and receive data wirelessly.

B. WSN hardware implementation:

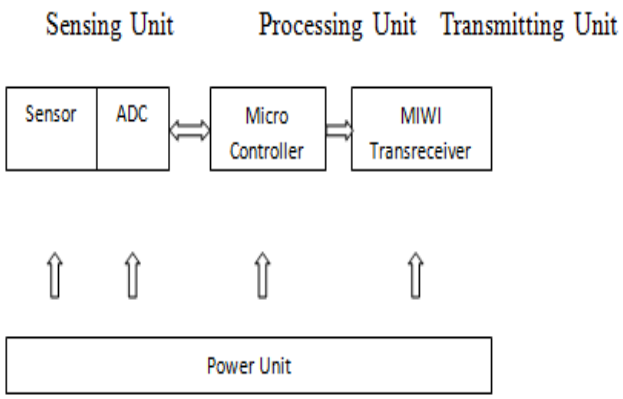

Figure.2. Block Diagram of Slave Mote

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Slave mote collects sensor data and compute on this information to display the physical parameters on the PC. The purpose of the Slave motes is to obtain physical data and transfer this using a protocol stack when required by the Master mote at certain time intervals. It consists of following components: Sensor, Micocontroller, Transreceiver & Power supply.

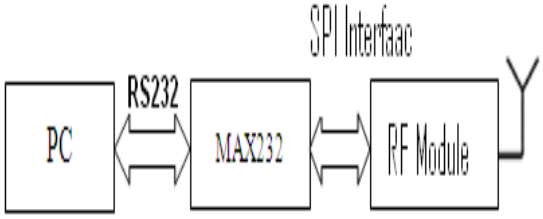

Figure 3 . Block Diagram of Master Mote

The function of master mote is to acquire, process, store, and display the physical parameters. The master mote implemented in the present work has following components to carry out its functions.PC,Max232,DB9 connector,MIWI Transreceiver &Power Supply.

C. Software Implementation:

Slave nodes PIC microcontroller programmed to data acquisition from sensor and communication with MIWI module. MIWI module configured in AT mode for slave nodes. The Master node requires the MIWI module configured in API mode. The LabVIEW needs to be program to acquire API frame and provide user interface for this application.

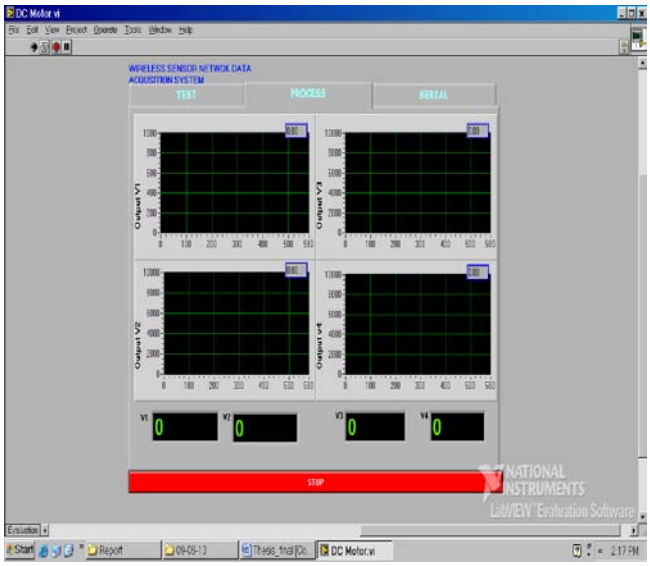

Figure.4. Front Panel MIWI Data acquistion system

The fig shows the block diagram as graphical programming representation for temperature sensor node API frame implementation. First data Send to master mode and received actual variable of field by MIWI wireless protocol . From received Modbus frame data is extracted and update appropriate physical variable.

III. TESTING AND RESULT

The designed hardware is implemented and tested several times in different condition to determine the range, reliability, current consumption. The results are highly encouraging and discussed as follows

A. Reliability:

The hardware designed is highly reliable. The hardware delivered satisfactory performance for almost 100% of the time. Out of an approximate 50 times that the hardware was switched on for operation, it functioned 49 times perfectly as it should be working.

B. Range:

Practically testing for 30m successfully because of limitation of environment for range testing in LOS for MIWI Pro module. The range of MIWI is 1.6km outdoor if extra power amplifier and external antenna connected.

Table 1.2 : Rf communication range test result

No	Date of Testing	Site	Result
1	01/09/2013	Laboratory	20m
2	01/09/2013	Laboratory	30m

C. Current Consumption Test:

This test is carried out using connecting 9V from power supply to the module. IC 7805 converted into 5V which is converted into 3.3V for MIWI Pro operation by IC LM1117 level translator. The electric current consumption in various cases summarized as following table:

Table 1.3: Current consumption test result

Test No	Date of Testing	Node Functionality	Site	Results
1	01/09/2013	Transmitting	Laboratory	27ma
2	01/09/2013	Receiving	Laboratory	10ma

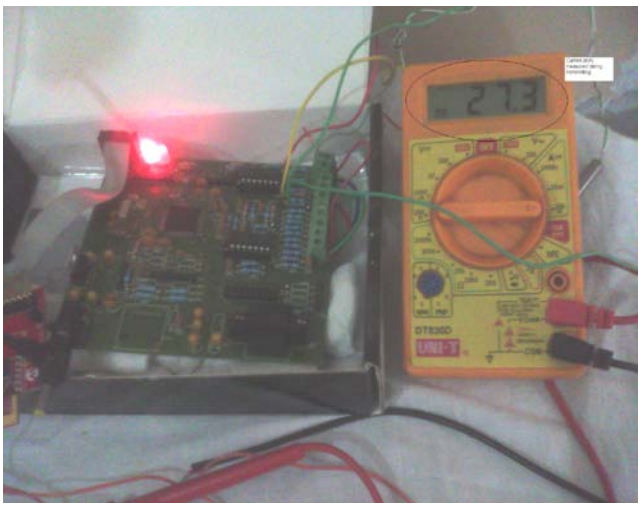

Figure. 5. Current Measurement in Transmitting Mode

IV. CONCLUSION

A functional network with one coordinator node and one slave sensor nodes are deployed. However, owing to the time constraints and the non-availability of the required components, the project is carried out with the components specially sensors available in the laboratory or market. Develop integrated nodes package functional in the industrial environment and mounting will cause better success of project.

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Both hardware and software were extensively tested. Due to lack of specialized equipment, only limited range of hardware features are tested. The different options and situations which appear during exploiting MIWI modules are detailed through the development of our LabVIEW designed system. Programming and monitoring real data sensors according to users' needs and recommendations are the only procedures which have to be added for achieving a complete network system.

We may conclude that in near future, WSN field will be expanding rapidly so its design phases appearing now to be highly complex and involving interdisciplinary approaches will see substantial reductions. The WSN state-of-the-art technology and its impact on human life are the focus of advanced industrial poles and scientific communities so we will see widespread applications entering in everyday activities.

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