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Distributed System for Weather Data Collection through TINI Microcontroller

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***Abstract*—The present work described hardware and software descriptions of data acquisition through a dedicated TINI microcontroller connected to the Network using Ethernet technology. One wire devices are connected to this microcontroller. The system collects the data over a distributed network. The data is analyzed and results are stored in a central database. The interactive features are also included through user interface for complete control.**

***Index Terms*— Distributed Database, TINI, 1-Wire,**

I. INTRODUCTION

Cheap, reliable, portable and automatic data acquisition systems are required for rural remote based applications. Each sensor in a weather station require its' own wiring and power supply. Adding sensors to an existing station brings additional complexity. The thermometers used to record the maximum and minimum temperature are required to reset each time. In this case possibility of error could not be neglected. Automation of these monitoring systems increases the reliability along with easy availability of data. The paper describes a distributed embedded system which could be used for applications where data has to be collected and transmitted at multiple locations and at regular time interval. The system can be operated independently and automatically with minimum human interaction [1, 2].

II. METHODOLOGY

In this work, local area network based distributed monitoring system is being developed for collection of environmental parameters like temperature, humidity; wind direction etc. The heart of the system is TINI microcontroller card. The card supports TCP/IP protocol so remote monitoring becomes very easy. HTML based GUI for this purpose has been developed. The parameters is acquired using legacy device interfaced with serial port of the microcontroller. This device will read humidity sensor, 1-wire temperature sensor and 8 switches based wind cock for wind direction.

III. EXPERIMENTAL SETUP & SCIENTIFIC APPROACH

The main objective of developing this embedded system is to create systems that can operate independently and automatically, with minimum human interaction remotely. The fig (1) shows the architecture of the remote weather parameter monitoring system (RWMS). The schematics is divided into two parts,
1) A Remote Area Station 2) A Server Station.

A Remote area substation consists of web enabled networked microcontroller i.e. TINI microcontroller and legacy device with sensors. For the purpose of remote monitoring, these remote substations must necessarily be connected to server station via network. In this regard the TINI microcontroller developed by Dallas semiconductor provides the ready solution [3]. The TINI microcontroller board is web enabled so it can be directly connected to internet. Both local and wide area networks can be accessed using the IPV6 stack.

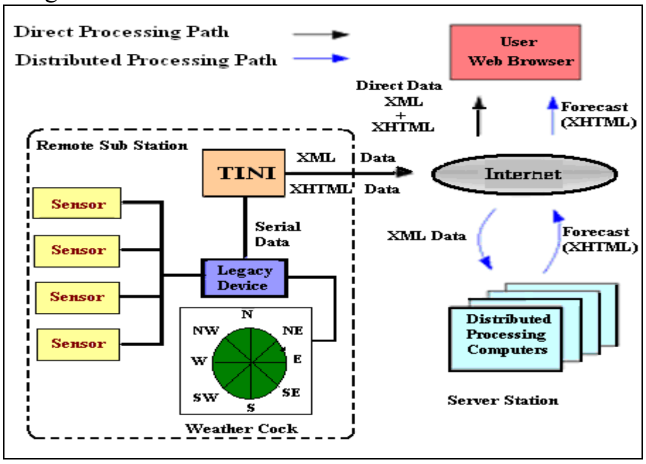

Fig (1) The Architectural Design of Remote Weather parameter Monitoring System (RWMS).

Direct support for Ethernet allows designs that connect to a LAN. PPP enables IP over serial, which supports networking over wireless connections or through phone lines using analog modems. We have used 1-Wire temperature sensor [4] which is a semiconductor device and does not require any glue logic. The name is derived from the fact that it only uses 1 wire for communication hence many of such 1- wire sensors could be connected. The operating range of 1-wire temperature sensor is -55 C to +125 C with an accuracy of ±0.5C.

Humidity measurement is the more difficult problems in basic meteorology. Relative humidity is a function of temperature and absolute moisture content, so small temperature variations will affect the relative humidity. Generally Hygrometers are used for humidity monitoring. For humidity measurement we have used HC3223 sensor. It is highly resistant to chemicals. The results of humidity are not affected by water immersion. The operating range of humidity is 0 to 99% RH [5]. The humidity sensor gives frequency corresponding to relative humidity.

Wind cock is made using 8 switches. The Legacy device read all these and display the parameters on 20x4 LCD display.

IV. Software And Results

The system software plays an important role in this system, both on user side as well as on server side. As IP networks have become more pervasive, it is now a necessity to develop network enabled embedded systems. However, network protocols tend to be complicated to code and require a lengthy test cycle. The runtime environment provides the entire software infrastructure needed to write network-aware applications for IP-ready microcontrollers. The runtime environment provides a full TCP IPv4/v6 protocol stack verified for compliance to Internet standards. The network stack is driven by a multitasking operating system. Since we have used TINI having embedded java, we have developed an application software in Java and used ON-board peripherals using the runtime environment and its built-in APIs,

To make the class files compatible with the TINI platform all are converted in to .tini files using tini convertor. FTP is used to upload all the files for the GUI on to the TINI. The execution of this server software is done using Telnet session.

V. System Flow

The working of the weather station is explained in the form of system flow chart in fig (2).

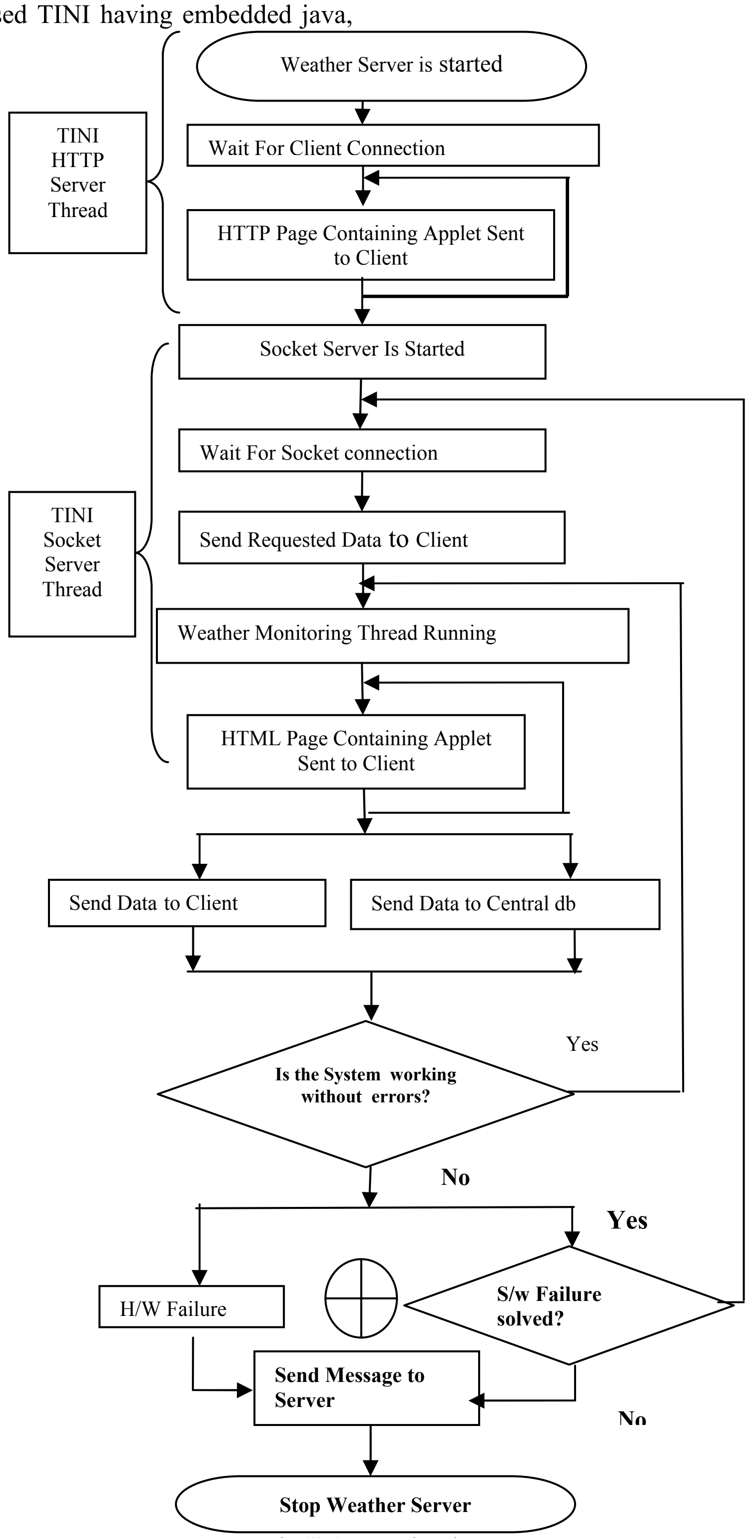

Fig (2) System Flowchart

The flowchart shows that weather server is initiated and it is ready for client connection. When the client sends requests to the web server, the HTTP page containing applet is sent to the client. This process is handled by TINI HTTP server thread.

By the end of this process the socket server is initiated. This socket server waits for socket connection. Once the connection has established the server client communication starts. The data is sent to the clients on request. The weather server starts and HTML pages containing applet are sent to the client. This is a continuous process. This applet is handled by TINI socket server thread. The data is sent to client and to the central database at certain user defined time interval. Before sending data to be inserted into database, all the parameters are compared with the previous data. If there is any change in any of the parameters, data is sent for the insertion. This process is repeated continuously.

VI. Feasibility of the System

The feasibility of the embedded system is studied [6] with respect to the following points:-

A. Software Up gradation Capabilities

In the development of the embedded system we have used advanced microcontroller and corresponding development environment tools, so the embedded system software development, the development process gets more flexible. Further we can modify and upgrade the software as well as the hardware.

B. Size

The size of embedded system is the important factor. The care has been taken while developing the embedded system that it should be portable, easy to handle and install. Our embedded system is very small in size, portable and easy to install.

C. Fault Tolerant

The system can recover from component failure if any. It is easy to replace the failed component and resume the system with newly installed components.

D. Recoverable

The failed processes during the fault or failure of component can be initiated easily and therefore, the embedded system is recoverable.

E. Power Consumption

This embedded system needs around 3W power. The embedded system is feasible in terms of power consumption. A simple solar system could be used to charge 6V battery in the remote areas.

F. Cost

While designing an embedded system, cost is the most important factor. Initial cost of developing, debugging and testing the hardware and software cost is only one–time. Our embedded system costs less than $100 which is less as compared to the other embedded systems developed for weather monitoring.

VII. Conclusion

Development of an automated weather monitoring system which is more reliable and accurate way of monitoring the Weather parameters such as Temperature, Humidity, and Wind Direction of any area compared to existing manual systems is described. The system is particularly useful in remote areas where the manual supervision of weather parameters is not convenient.

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