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Design and Implementation of General Purpose Remote Terminal Unit (R.T.U)

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Abstract

This paper introduce the design and development of multifunctional sensor nodes, the design based on microcontroller which represent the heart of any low cost R.T.U. A small size R.T.U can be used as a server provides the required data in the remote area. The proposed R.T.U is of low cost, low power, easy to implement and efficient to be used in different applications.

Index terms— efficient, implement, multifunctional, development

1 Introduction

elemetry is the science of gathering information at some remote location and transmitting the data to a convenient location to be examined and recorded, when telemetry is used both to monitor and control, the term supervisory control and data acquisition (SCADA) is often used to describe the system. [1] Telemetry system consists of three parts, which are: central unit, RTU and communication media. [2] A remote terminal unit (R.T.U) is a microprocessor-controlled electronic device that interfaces objects in the physical world to a central unit or SCADA by transmitting the required data to the system and sometimes by using messages from the central unit to control connected objects. [2] The remote terminal unit consists mainly from three major parts (sensors, microprocessor or controller, Communications parts), Each R.T.U composed from the sensors that provide the required data for a certain application, the microcontroller which is the most important part of the R.T.U that collect the data from the sensors, process it and give it to the communication part for delivering it to the central unit. [2] Microcontrollers are devices also known as computer in a chip, the design in cooperates all of the features found in a microprocessor (CPU, ALU,PC,SP to be a complete computer : Rom, RAM, serial and parallel I/O, counters and a clock circuit. The prime use of the microcontroller is to control the operation of the R.T.U using a fixed program which is stored in ROM. [3] The microcontroller is an embedded system which is used by individuals, who are, in the main, unaware that the system is a computer-based. The microcontroller is not flexible, it does not have an operating system; it's programmed to perform the required task. [4] The microcontroller inside the R.T.U itself can not send data over any transmition media unless it is interfaced with parts or IC's capable of doing that [1].

To make the proposed R.T.U send data over computer networks, the controller inside the R.T.U need to have a TCP/IP protocol in the code memory making it an Ethernet node, well the controller also needs special parts that allow us to reach this media. [5] Ethernet is the technology for LANs, Standardized in IEEE 802.3. In the OSI reference system, Ethernet is at the Data Link layer. used to connect computers in home and offices. It is also possible to interconnect networks by router and Gateways end with WANs. [6] TCP/IP is a suite of protocols used in the internet to allow communication between computers, it is a layered protocol based on the open system interconnection OSI model, The term TCP/IP refers to communications that use TCP and IP protocols. The proposed R.T.U was implemented by using the following electronic components ? PIC16F887 Microcontroller. ? LM35 and DS18s20 as a temperature sensors. ? ENC28J60 as the Ethernet controller.

2 ? Keypad and LCD

The PIC16F887 microcontroller has an 35-I/O pins, 14-I/O pin can be programmed to be either analogue or digital inputs, the other I/O pins can interface digital inputs. [7] The first step of implementing the proposed design of Ethernet system is to interface the microcontroller (PIC16F887) with sensors, accessory part and the

Ethernet controller 28J60. These interfaces include the hardware connections and programs reside in the mind of the microcontroller, the details can be summarized by the following sections i. data collection part

The data collection section is performed by interface the PIC16F887 with sensors. The sensors identify which data is to be collected such as temperature, pressure, humidity, force and etc. LM35 and DS18s20 were selected as examples of analogue and digital sensors respectively.

The LM35DZ is an analogue sensor that is used for reading temperature range from -55 º to + 150 º. The PIC16F887 microcontroller has a built in Analogueto-digital (ADC), so that the sensor's analogue signal can be connected directly to the analog input of the microcontroller.

DS18S20 is an example of digital sensors that read temperature provides 9-bit centigrade temperature measurement range from -55º to +125º.

In the implemented R.T.U two LM35 and two DS18S20 were connected to the PIC 16F887.

ii. Accessory Part Adding a keypad and LCD display to the proposed R.T.U give to it aesthetic, not only this, in some applications the user want to interact with the R.T.U such as give it a new IP address or see some results, in the designed and implemented Ethernet R.T.U keypad and LCD display were added for security assigning a password to R.T.U.

3 iii. Ethernet module part

The PIC16F887 microcontroller can be connected to the computer network media via an Ethernet controller unit.

Microchip ENC28J60 is a stand-alone Ethernet controller with SPI (Serial peripheral interface). The ENC 28J60 meets all of the IEEE 802.

4 Result and Discussion

The Ethernet R.T.U was designed and implemented successfully as shown in figure (5). The technical specifications for the R.T.U are:

? Supplied voltage: -5volt.

? Operating frequency: -5Mhz.

? Output current: -100mA.

? Bit rate: -10Mbs. When the R.T.U is switched ON the LCD display shows a "Enter the password "message. The password should be entered by the user correctly. Then LCD shows a "OK" message and activate the other part of the R.T.U.

When the implemented R.T.U is connected to central unit, clicking on the connect command field will start a connection and request the implemented R.T.U to send its data to central unit, the R.T.U collects the data from the sensors process it and send it to central unit.

In the central unit the data has been received from R.T.U is displayed in Temp 1, Temp 2, Temp 3 and Temp 4 fields as shown in figure (7). The data base and the access sheet store the received data at the exact time and date on which the data was collected.

The benefit of having a data base is to provide reliable persistent storage and the ease of extract data to obtain reports.

5 Conclusions

In this paper a telemetry system was designed and implemented. The remote terminal unit which was designed and implemented has the following features:

? Low cost and small size RTU unit.

6 ?

PIC16F887 microcontroller gives the proposed system the ability to be used in different applications.

? The use of Ethernet facilitates the communication mechanism allowing the proposed system to run over any computer network infrastructure.

? The designed software in the central unit allow data to be stored in a database which provide reliable persistent storage. This allow The ease of extract data and obtain reports and the ease of data management to some level of quality.

? The use of Internet Browser allows the data to be shared in many locations that have access to the designed web page.

? The use of TCP ensured the delivery of packets on the contrary of the use of UDP which is unreliable.

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[1] [2] [3]

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Figure 1: Figure 1 :

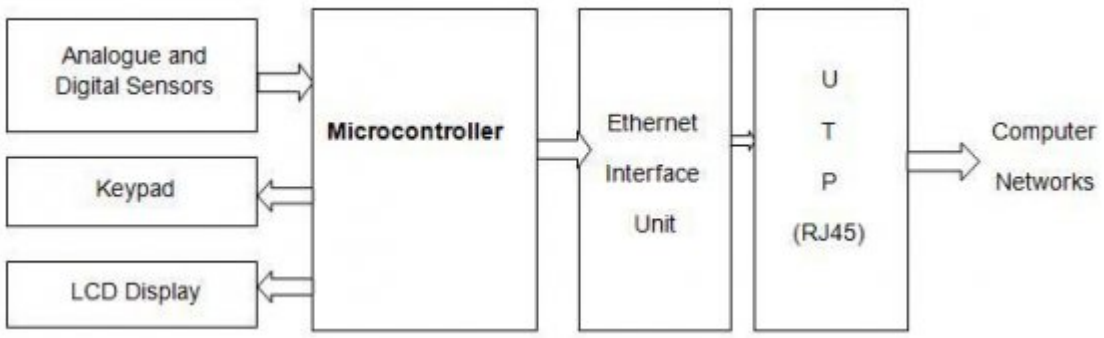

Figure 2:

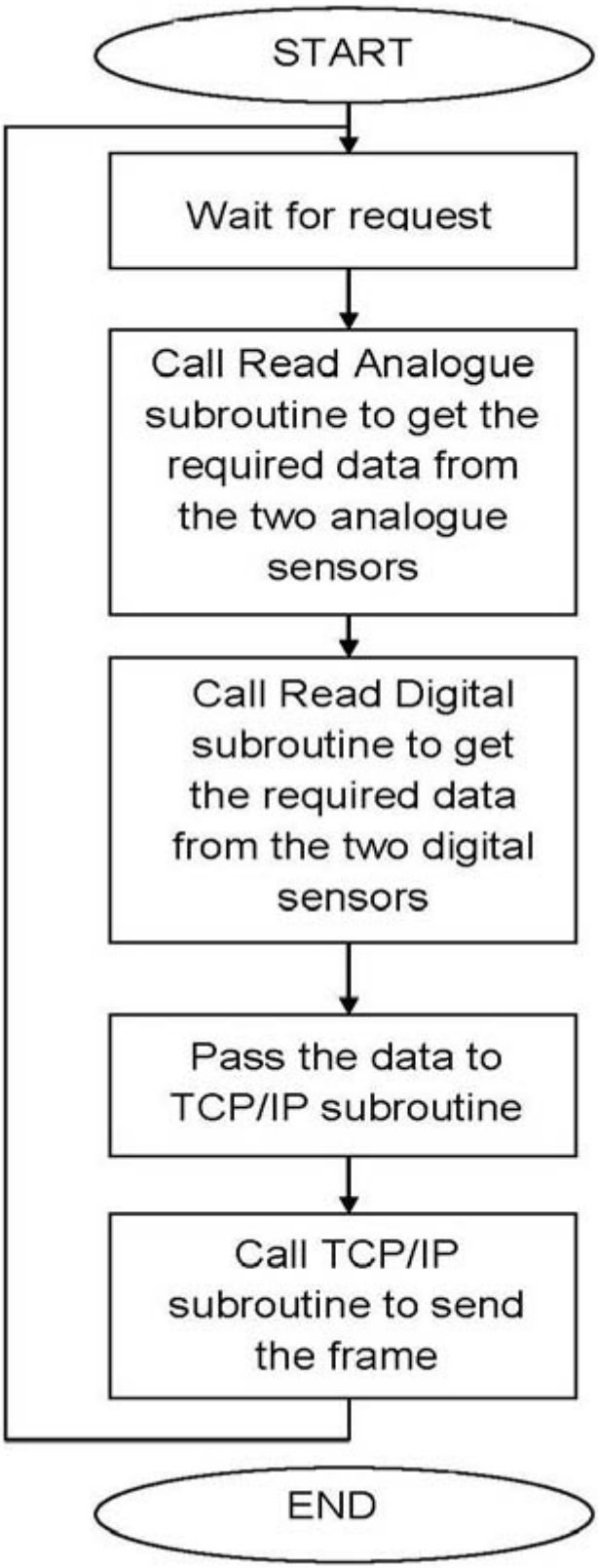

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Figure 3: Figure 2 :Figure 3 :

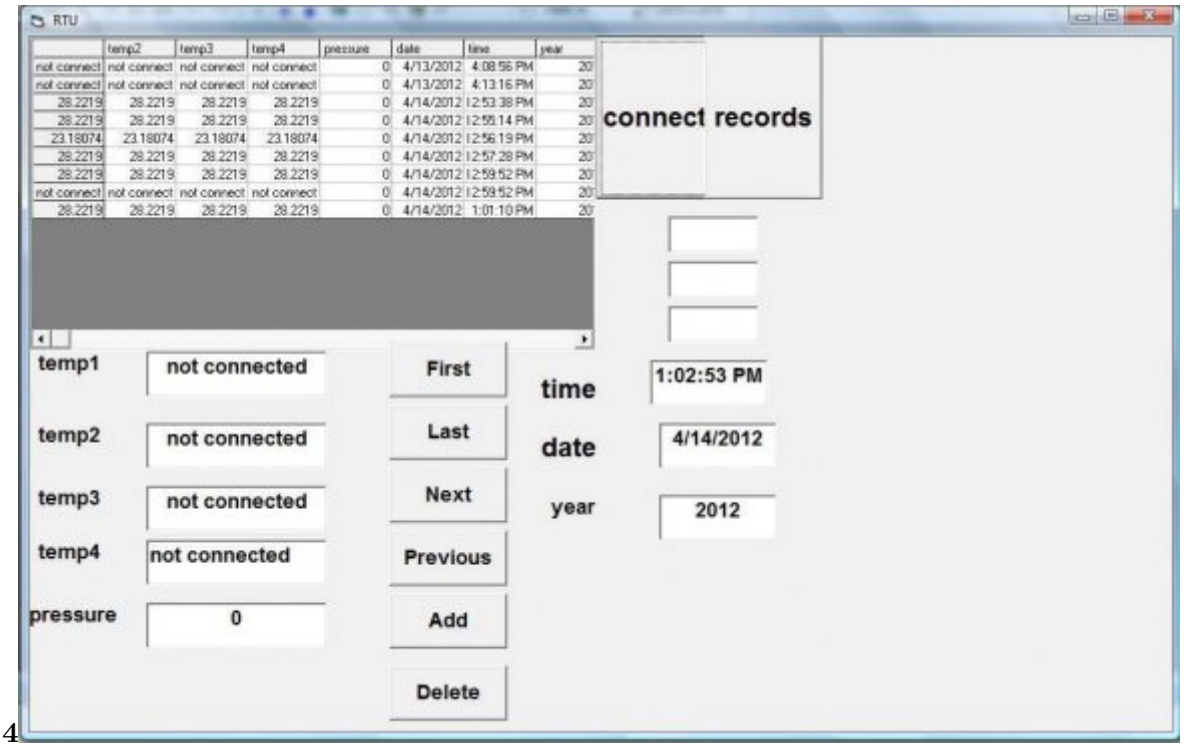

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Figure 4: Figure 4 :

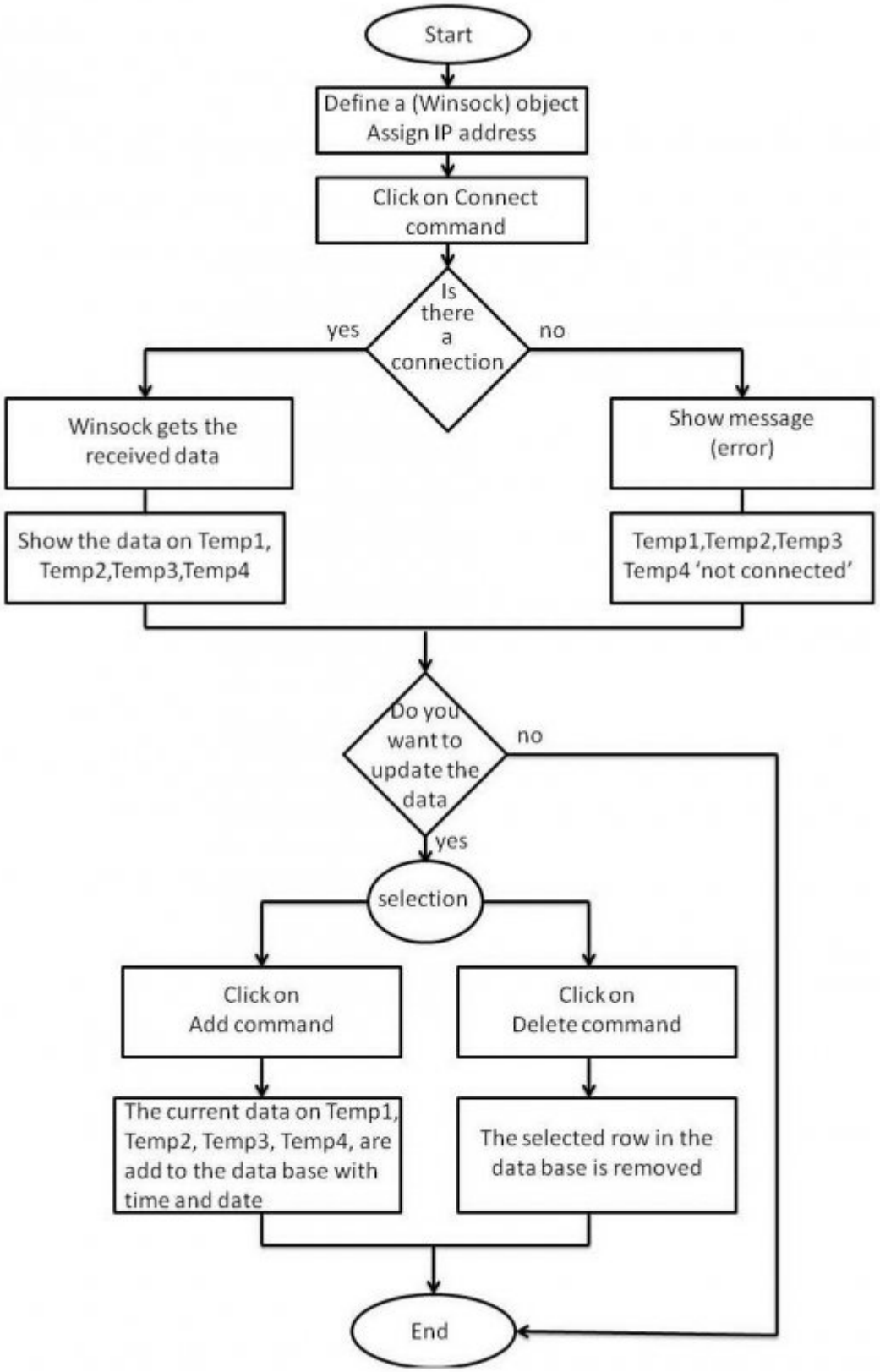

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Figure 5: ?Figure : Figure 6 :

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Figure 6: Figure 7 :

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Figure 7: Figure 8 :Figure 9 :

Figure 8: Volume

Figure 9:

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