GPRS Transmission of on-site Temperature Variations

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ABSTRACT
Prior to the occurrence of natural calamities on earth, it has been observed that large variations occur in ambient temperature. In spite of the large amount of research work going on worldwide, methodology and instrumentation for accurate prediction of natural calamities (even a few hours before their occurrence) has remained elusive.In this paper we have developed an instrumentation system that detects increase in seismic activity and in turn helps us to predict the occurrence of the natural calamity well in advance. Large variations in temperature occur much before and during such times.*We have used a* Quartz based Temperature Sensor to monitor this parameters associated with increased seismicity.The Quartz Crystal HTS-206 is embedded 25meters deep in the ground to detect the variations in temperature.The data is logged ,analysed and further transmitted by using GPRS network on to the Internet through the GPRS Intelligent Modem.

General Terms
Measurement, Documentation, Performance, Design, Reliability, Experimentation, Verification.

KEYWORDS
Quartz sensor,Transceiver 75176B Transmitter,Transceiver75176B Receiver,microcontroller 89C51RD2,MAX RS 232,GPRS

1. INTRODUCTION
Natural calamities can be caused by a variety of things, including meteor impacts and volcanic eruptions, and sometimes evenman-made events like mine collapse and underground nuclear tests. But most naturally occurring surface calamities are caused by movement of pieces of the Earth's surface, which are called **tectonic plates [1]**. Earth tides can also trigger calamities. Earth tides are produced by the gravitational pull of the moon and the sun on the earth, this causes the ocean's water to slosh which in turn raise and lower the stress on the faults roughly twice a day. The calamities would have happened anyway but Other times, the edges of the two plates will push against each other and rise upward, forming mountains. During such activity large amount of seismic waves are released from the earth's atmosphere [2].

We have developed an instrumentation system that detects the increase in seismicity which in turn will predict the expected occurrence of the natural calamity. Large variations in pressure and temperature occur much before and during the seismic activity. A large amount of heat energy at the earth's core tries to find a path to come out from one way or the other. The portion of earth's crust, which gets affected the most due to this, is the core of the seismic zone [2] .
It was observed that the tap water was hot even during winter, much before (a month, approximately) the natural calamity struck Bhuj, Gujarat on 26th Jan 2001.This created more interest and initiated us to study more about the structure of the earth's crust and the temperature variations as we go from the surface to the earth's core. This system has been developed for the first time by us for the above purpose

Thus, the research work presented here is an effort to develop an electronic technique (using Quartz Sensor) in this direction, viz. for the precise detection of the variation of the physical parameters related to natural calamities well in advance to prevent the colossal loss of life and property.

2.INSTRUMENTATIONAND INTERFACING

Here we discuss the sensor selection and the basic idea of the instrumentation system developed. We also give the detailed explanation and working of the instrumentation developed.

2.1 Block Diagram
The block diagram of the Sensor Instrumentation developed in this research work is shown in Figure 2. The HTS-206 Quartz crystal is a temperature sensor (stress compensated). The crystal along with its associated circuitry forms an oscillator circuit [3][4]. The Quartz Crystal HTS-206 is embedded 25meters deep in the ground to detect the variations in temperature. Sine waves are produced having a frequency of 39.4012 kHz which is the natural frequency of the crystal. As the temperature of the site increases, the frequency of the oscillator decreases. These sine waves are further transmitted to a distance of around 90meters with the help of a pair of Differential Driver Transceivers 75176B through wires. The waveform observed at the output of the Receiver is given as input to one of the input Port pin of the microcontroller 89C51RD2. The µC 89C51RD2 is programmed such that it reads the square wave from its input port pin and calculates the frequency of the square wave with the help of the internal timers which is then transmitted through its output port pin to the MAX RS - 232 serially[5]. The received signal frequencies are transmitted to the PC serially.

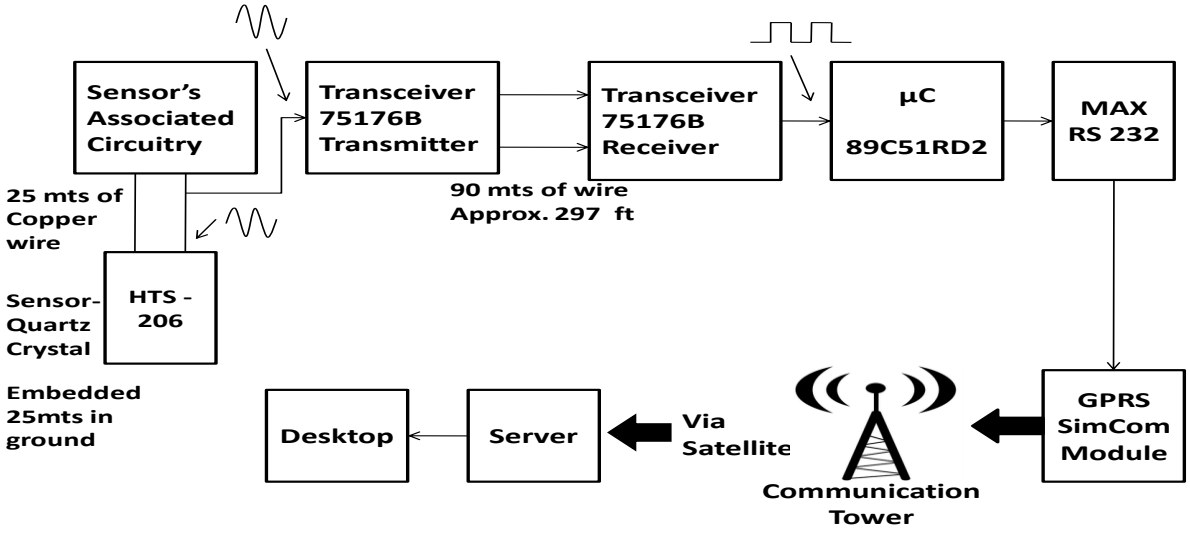


Figure 2 Block diagram

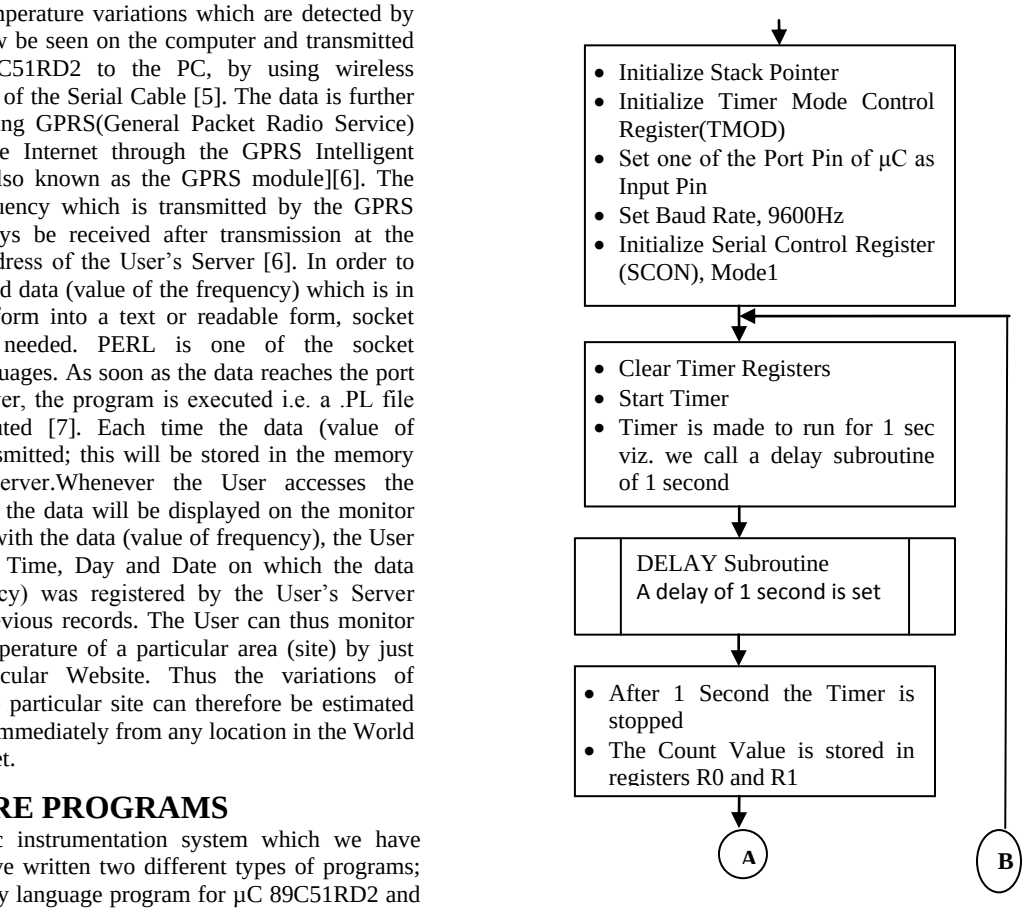
Hence the site temperature variations which are detected by the sensor can now be seen on the computer and transmitted from the µC 89C51RD2 to the PC, by using wireless techniques instead of the Serial Cable [5]. The data is further transmitted by using GPRS(General Packet Radio Service) network on to the Internet through the GPRS Intelligent Modem (GIM) [also known as the GPRS module][6]. The value of the frequency which is transmitted by the GPRS module will always be received after transmission at the specified Port Address of the User's Server [6]. In order to read the transmitted data (value of the frequency) which is in the ASCII HEX form into a text or readable form, socket programming is needed. PERL is one of the socket programming languages. As soon as the data reaches the port of the User's Server, the program is executed i.e. a .PL file program is executed [7]. Each time the data (value of frequency) is transmitted; this will be stored in the memory of the User's Server.Whenever the User accesses the particular Website the data will be displayed on the monitor of the PC. Along with the data (value of frequency), the User can also read the Time, Day and Date on which the data (value of frequency) was registered by the User's Server along with the previous records. The User can thus monitor the change in temperature of a particular area (site) by just visiting the particular Website. Thus the variations of temperature of the particular site can therefore be estimated by the researcher immediately from any location in the World through the Internet.

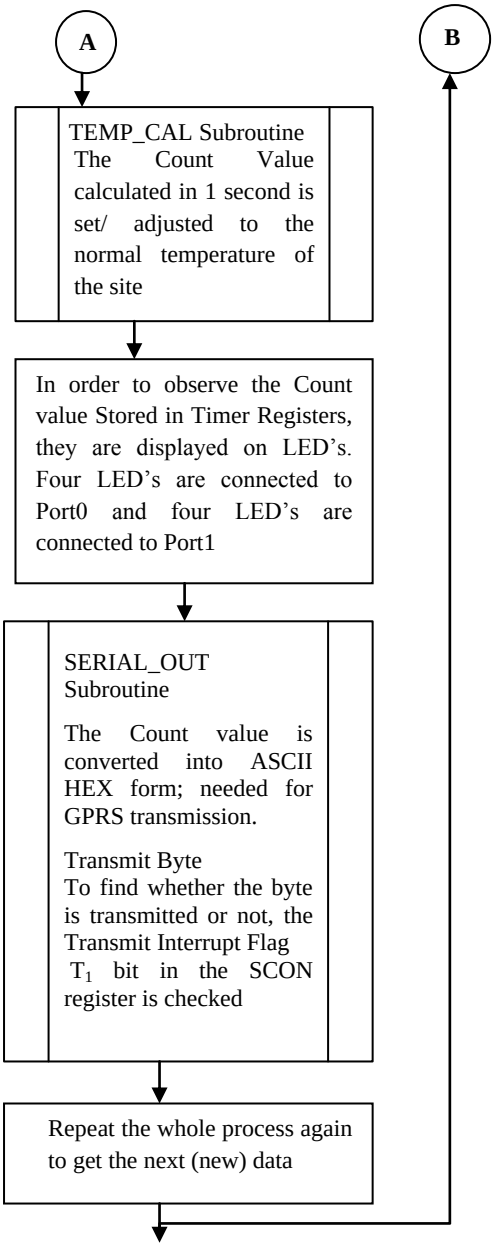
3. SOFTWARE PROGRAMS

For the electronic instrumentation system which we have developed, we have written two different types of programs; one is the assembly language program for µC 89C51RD2 and the other is the socket programming program in PERL language.

The variation in the temperature detected from the site area is measured in terms of the change in frequency in the form of sine wave.

3.1 Flow chart





4. OBSERVATIONS

4.1)Output observed at the Sensor Output:

The variation in the temperature of the site area is detected by the Quartz Sensor HTS-206 in terms of frequency. The Quartz Crystal HTS-206 is interfaced with PIC16F84 through 25mts. of Copper wire (32 SWG =0.274 mm in diameter), along with other components to form an oscillator circuit. This oscillator generates a sine wave whose frequency also varies as the temperature around the crystal is varied. The sine wave observed at the CLKOUT pin of PIC 16F84 is the output of the sensor.

4.2) Output observed at the Output of the Differential Driver Transceiver 75176B (Receiver)

The variations in the temperature, detected by the Quartz Sensor HTS-206 in terms of frequency; is then transmitted from the site area by Differential Driver Transceiver 75176B (Transmitter) through 90mts of wires to the Laboratory (Control Room). At the receiving end the Differential Driver Transceiver 75176B (Receiver) receives this change in frequency; which has the same frequency as that of the sensor, gives an output which is in the form of a square wave.

5 RESULTS

5.1) Graphical Analysis

As the temperature around the crystal is varied, the frequency also varies. It has been observed that as the temperature increases, the frequencyof the crystal decreases. Hence the Quartz Crystal HTS-206 detects the variations in the temperature in terms of frequency. The frequency variations of the Quartz Sensor with the change in temperature are plotted accordingly.The observed decrease of frequency is *1.48Hz*for every rise in temperature by 1^oC. This change in frequency is then transmitted from the site area to the control room (laboratory) which is at a distance of 90mts from the site area

5.2 Output Obtained at the HyperTerminal

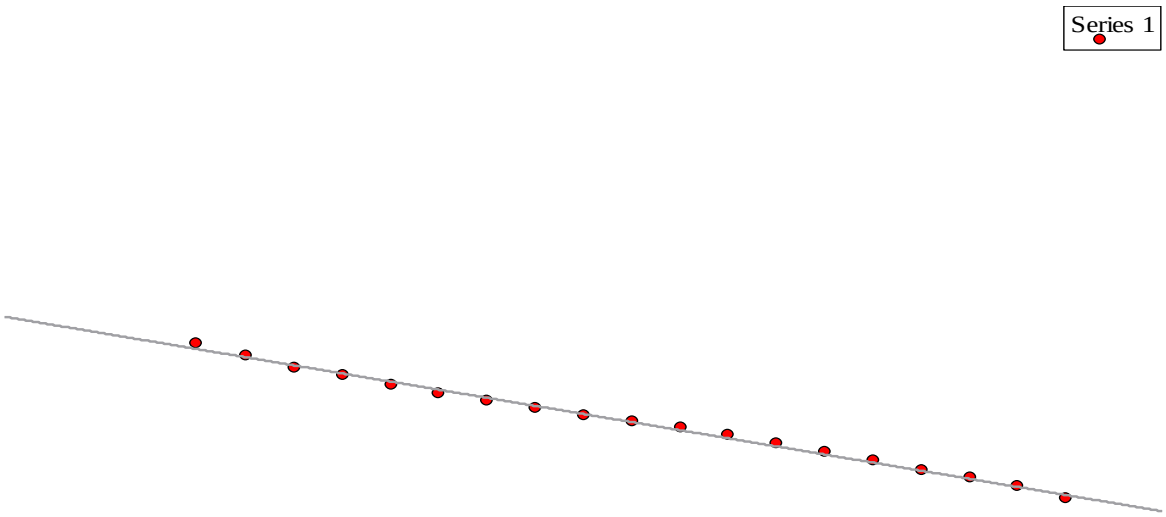
The ASCII HEX values calculated by µC 89C51RD2 is then transmitted through MAX RS-232 to the PC (Desktop) with the help of the Serial Connector. The following ASCII HEX values were observed on the HyperTerminal of the desktop which is installed in the control room (laboratory) situated 90mts. away from the site area where the temperature is being monitored. The observed ASCII HEX values are the equivalent temperature values measured from the site area and they are in accordance with the results as expected.

5.3) Output Observed on the Website without the PERL program

The value of frequency i.e. the temperature equivalent ASCII HEX data after transmitted by the GPRS module is received at the Port of the User's Server. These ASCII HEX values received, when observed on the website without the execution of the PERL programs are observed in the form of a table as shown below. This data is observed on the Website "www.surassa.com/cgi-bin/getS2.pl". The table shows the (value of frequency) i.e. temperature equivalent ASCII HEX data along with the Day, Month, Date, Time, and Year on which the data (value of frequency) was registered by the User's Server.

Table 1

Day	Month	Date	Time	Year
Mon	Jan 2C	3	10:52:35	2011
Mon	Jan 1C	3	11:03:40	2011



Graph 1

5.4) Output Observed on the Website after execution of the PERL Programs

The value of frequency i.e. the temperature equivalent ASCII HEX values (data after transmitted by the GPRS module is received at the Port of the User's Server. In order to observe these values on the Internet i.e. on a Website, in a text form or readable form, programs written in PERL language have to be executed. The first program collects the data sent by the GPRS module from the Port of the Server and stores it in the Server in a database form and the second program displays the result on the Website in a readable form whenever the particular Website is browsed. In the first program the total data (ASCII HEX values) received are divided into three levels:

If the ASCII HEX value is 30 or less than 30, viz. if the temperature of the site area is 45^0C or less than 45^0C, it will indicate **"Normal Activity"**.

If the ASCII HEX value is between 30 and 38, viz. the temperature of the site area has increased and it is between 45^0C and 55^0C, it will indicate that **"SomeActivity is being developed"**.

If the ASCII HEX value is above 38, viz. the temperature of the site area has increased beyond 55^0C it means that some serious (dangerous) activity is being developed and then it will indicate **"Cause of Concern"**

The following is the result, as observed on the Website after the execution of the PERL programs.

www.surassa.com/cgi-bin/getS2.pl

6. CONCLUSIONS

Various Earth Temperature measuring Sensors like RTD's etc have been used for monitoring the temperature of the Earth. Using the electronic instrumentation developed by us, a Quartz Crystal is used as a temperature sensor. We have used Quartz Crystal HTS-206 which is a highly sensitive temperature sensor. This Quartz Crystal HTS-206 is used in conjunction with an oscillator. It detects the temperature variations in terms of frequency and gives us a frequency variation of 1.48Hz per 1^oC change in temperature. Hence even if there is a 1^oC variation corresponding to the physical parameter in the neighbourhood of the location of the sensor, we are able to detect it. These temperature variations are then transmitted from the site area through a pair of Differential Driver Transceivers (75176B) along with µC 89C51RD2 and MAX 232 to the PC (HyperTerminal) in the Control Room (laboratory) which is situated at a distance of 90mts away from the site area. Thus, these temperature variations of the site area can be monitored on the PC (HyperTerminal) in the Control Room (laboratory) which is 90mts away from the site area .These temperature variations are further transmitted wireless from the Control Room (laboratory) through the GPRS module onto the Internet This enables to monitor these temperature variations from anywhere around the world by just browsing the particular Website.

7. NEW FINDINGS

1)An electronic instrumentation system based on Quartz Crystal HTS - 206 has been developed for the first time to measure the variations in the environmental energy parameter. This is interfaced to the pair of Differential Driver Transceivers (75176B), along with µC 89C51RD2 and MAX 232, enabling us to measure these variations as manifested by the temperature changes. The temperature variations of the site area are thus monitored on the PC (HyperTerminal) in the Control Room (laboratory) which is 90mts away from the site area.

2)We have also monitored these temperature variations with wireless systems using GPRS with the help of Software

Programming in PERL language. The advantage of GPRS transmission is that these temperature variations can be monitored by anyone from any location in the World through the Internet.

8. ACKNOWLEDGMENTS

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