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Patient Monitoring System Using GSM Interfaced With LabVIEW

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Abstract:
The health care sensors are playing a vital role in hospitals. The patient monitoring system is one of the major improvements because of its advance technology. This project proposes a system that provides temperature and humidity monitoring system based on GSM interfaced with LabVIEW. In hospitals either the nurse or the doctor has to move physically from one person to another for health check, which may not be possible to monitor their conditions continuously. The body temperature and humidity from sensors are then transmitted wirelessly to the specified mobile number which in not in the vicinity of the patient through GSM technique. Also we came up with a LabVIEW based monitoring system which can monitor and record temperature and humidity. The ease of operation and use of the LabVIEW software make it more suitable to this process.

Keywords: Temperature and humidity, LabView, GSM

1. Introduction

The aim of this system is to measure the temperature and humidity and send them to server for continuous monitoring and recording. A device will be attached to the patient with temperature sensors and humidity sensors. The body temperature exceeds the provided threshold value. This threshold value is defined by the programmer at the time of programming the microcontroller. The critical value of humidity that is given by the programmer. This information, i.e. the Body Temperature and humidity is then transmitted wirelessly to the doctor which in not in the vicinity of the patient through GSM technique. The software used is Cand, the hardware used are GSM modem, temperature sensor, humidity sensor and microcontroller.

The system also contains the software part   LabVIEW, through which we can monitor and record   the temperature and humidity variations.
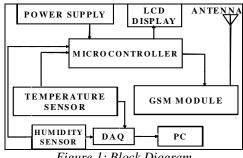
2. Methodology

Figure 1: Block Diagram

The block diagram includes mainly two parts of the project:
Sending message to a specified number through when measured values (temperature and humidity) crosses the given threshold value.
Monitoring and recording the corresponding values through lab view
The different components in the block diagram are,

1. Sensors
2. Microcontroller
3. Liquid Crystal Display
4. GSM
5. DAQ
6. PC

Here the sensors will sense the parameter change. The obtained values will compare with the threshold values of temperature and humidity that are already processed in microcontroller by programmer. In the first part of the project, if there occurs any variations such that the measured values crosses the given threshold values, the GSM get excited and the message will pass to the corresponding mobile number.

3. Sensors and Descriptions
The proposed system consists of mainly two sensors for measuring temperature and humidity. The temperature sensor LM35 and humidity sensor SY-HS-220 are used here.

3.1. Temperature Sensor
In this work we are using IC LM35 as a temperature sensor. The LM35 series are precision integrated circuit temperature sensors, whose output voltage is linearly proportional to Celsius temperature. The LM35 has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain its equivalent centigrade scaling. The LM35 does not require any external calibration or trimming to provide accuracy of +/- 25 ^{0}C at room temperature. Low cost is assured by trimming and calibration at water level. The LM35 is low output impedance, linear output, and precise inherent calibration make interfacing to readout.Features are calibrated directly in Celsius,Linear =10.0 mv/c scale factor,Suitable for remote application, Low cost due to water level trimming, Operation from 4 to 30 volts and Low impedance output.

3.2. Humidity Sensor
A humidity sensor also called a hygrometer, measures and regularly reports the relative humidity in the air. This means that it measures both air temperature and moisture. Humidity sensor gives regular, ongoing readings of the relative humidity, so they are usually used for data collection in the weather stations.
The humidity sensor SY-HS-220 can operate up to the range of 95% RH (Relative Humidity). The humidity sensor module itself contains the signal conditioning unit and the voltage out can take out through the connectors.
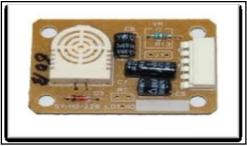

Figure 2: SY-HS-220 Humidity sensor

We know that the level of humidity in the air is also a function of temperature. Excess humidity can cause growth of fungus. Too little humidity can cause static discharge or accumulation of unwanted dust, contributing to allergies.
Here we use a humidity sensor known as SY-HS-2 and the module is SY-HS-220 series, which produces more accurate and linear voltage output. This is a polymer humidity sensor. The voltage output is directly amplified and given to the LabVIEW to monitor the value of humidity in the air. It is clear that the output voltage indicated is proportional to the intensity of atmospheric moisture content.

3.3. Features
1. Humidity sensor module with voltage output
2. Wide temperature compensation range
3. High reliability and long term stability
4. Linear dc voltage output for humidity range
5. High sensitivity and low hysteresis
6. Compact size and cost effectiveness

These features of the sensor make it more applicable in the measurement field. One of the main advantages is that it has high sensitivity, so that it will respond to the slight change in humidity.
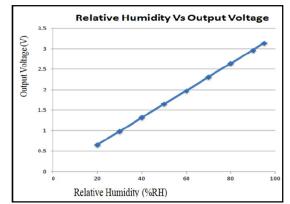

Figure 3: Relative humidity (%RH) Vs Output voltage (V) Characteristic Graph

4. Microcontroller

The Arduino, which uses the ATMega328, was selected as the microcontroller for this project. This was an ideal selection, as the processor is extremely strong and cost efficient.
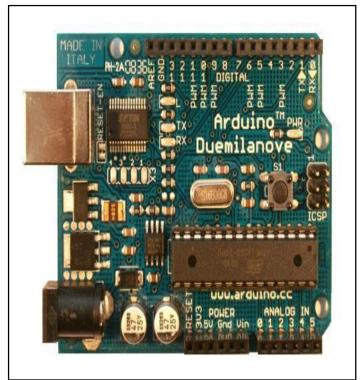

Figure 4: Arduino

An input voltage ranging from 0 – 5V is required, which corresponds with the humidity sensor. An on-board 10-bit analog to digital converter (ADC), aids in the digitization of the analog signal acquired from the sensor. Additionally, the temperature used in the prototype are specifically designed for the Arduino, which allows for simple integration with this microcontroller. The board also having 8-bit PWM pins, which are used to control the light and temperature effecters. The Arduino platform uses a language similar to C, so having been familiarized with the C programming language, it was convenient to use this microcontroller. Another reason the Arduino was selected is that it is a well known board with plenty of examples and references on the web to aid this project. Lastly, uploading the code from the computer onto the board was simple, since the software was available for at no cost on the Arduino website. The Arduino has a serial port to allow communication with the computer. The USB connection from the computer goes directly onto the Arduino board, where a USB to serial converter then allows communication to occur. This was necessary, since this project requires a user's input.

5. Global System for Mobile Communications

Figure 5: GSM MODEM

GSM originally from Group Special Mobile is the world's most popular standard for mobile telephony systems. The GSM Association estimates that 80% of the global mobile market uses the standard. GSM is used by over 1.5 billion people across more than 212 countries and territories. This ubiquity means that subscribers can use their phones throughout the world, enabled by international roaming arrangements between mobile network operators. GSM differs from its predecessor technologies in that both signaling and speech channels are digital, and thus GSM is considered a second in that both signaling and speech channels are digital, and thus GSM is considered a second generation (2G) mobile phone system. This also facilitates the wide-spread implementation of data communication applications into the system.

The GSM standard has been an advantage to both consumers, who may benefit from the ability to roam and switch carriers without replacing phones, and also to network operators, who can choose equipment from many GSM equipment vendors. GSM also pioneered low-cost implementation of the short message service (SMS), also called text messaging, which has since been supported on other mobile phone standards as well. The standard includes a worldwide emergency telephone number feature.

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. This GSM Modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. Advantage of using this modem will be that you can use its RS232 port to communicate and develop embedded applications. Applications like SMS Control, data transfer, remote control and logging can be developed easily. This GSM modem is a highly flexible plug and play quad band SIM900D GSM modem for direct and easy integration to RS232 applications. Supports features like Voice, SMS, Data/Fax, and GPRS.

Applications:
1. SMS based Remote Control & Alerts
2. Security Applications
3. Sensor Monitoring
4. GPRS Mode Remote Data Logging

Features:
1. Highly Reliable for 24x7 operation with Matched Antenna
2. Status of Modem Indicated by LED
3. Simple to Use & Low Cost
4. Quad Band Modem supports all GSM operator SIM cards

6. Data Acquisition

DAQ is data acquisition. It is device which contains both ADC & DAC in it. It is interface between analog output of sensor and the PC. The data traditional experiments in it signal from sensors are sent to analog or digital domain, read by experimenter, and recorded by hand. In automated data acquisition systems the sensors transmit a voltage or current signal directly to a computer via data acquisition board. Software such as LabVIEW controls the acquisition and processing of such data. The benefits of automated systems are many:

a. improved accuracy of recording
b. increased frequency with which measurements can be taken
c. potential to automate pre and post processing and built in quality control

7. Virtual Instruments

Virtual instrument is that in the general computer platform, users define and design the testing functions of equipment according to requirements, making users operate the machine like operate the same equipment designed by them. The emergence of the concept of virtual instruments, breaking the traditional definition of equipment from manufacturers, users cannot change the work mode, users can make according to its own needs, design their own instrument system, in the testing system and equipment design to make full use of software instead of hardware, take full advantage of computer technology and the expansion of the traditional test systems and equipment functions. "Software is equipment" is the simplest concept of virtual instrument also is the most essential expression. Virtual machines cannot work without computer control; design software of virtual instrument is the most important and most complex part.

Usually instrumentation manufacturers provide specific functions to the given architecture and fixed interfaces for measuring devices, and thus limit the application domain of these devices. In actual use much time is required for adjusting the measuring range and for saving and documenting the results. The advent of microprocessors in the measurement and instrumentation fields produced rapid modifications of measuring device technology, soon followed by the appearance of computer based measurement techniques. A single user controls the system, which runs exclusively on a piece of hardware. The measurement consists of three parts, acquisition of measurement data or signals, conditioning and processing of analysis of measurement signals and presentation of data. The concept of virtual instrument is frequently used in industrial measurement practice, but not always with precisely the same meaning. For some people, virtual instruments are based on standard computers and represent systems for storage, processing and presentation of measurement data. For others, a virtual instrument is a computer equipped with software for a variety of uses, including drivers for various peripherals, as well as analogue to digital and digital to analogue converters, representing an alternative to expensive conventional instruments with analogue displays and electronics. Both views are more or less correct. Acquisition of data by a computer can be achieved in various ways and for this reason the understanding of the architecture of the measuring instrument becomes important.

A virtual instrument can be defined as an integration of sensors by a PC equipped with specific data acquisition hardware and software to permit measurement data acquisition, processing and display. A virtual instrument can replace the traditional front panel equipped with buttons and a display by a virtual front panel on a PC monitor. Virtual instruments are a means of integration of the display, control and centralization of complex measurement systems. Industrial instrumentation applications, however, require high rates, long distances, and multi- vendor instrument connectivity based on open industrial network protocols. In order to construct a virtual instrument, it is necessary to combine the hardware and software elements which should perform data acquisition and control, data processing and data presentation in a different way to take maximum advantage of the PC. It seems that in the future the restrictions of instruments will move more and more from hardware.

8. Lab VIEW Software

The expanded form of Lab VIEW is Laboratory Virtual Instrumentation Engineering Workbench. A graphical programming language that allows for instrument control, data acquisition, and pre/post processing of acquired data. The main feature of this program is easy to use, faster development time, graphical user interface graphical source code, easily modularized, application builder to create stand-alone executable, multi-platform compatibility (perform natural and migrate applications between platforms). The entire Measurement and Automated system can be controlled with Lab VIEW locally, or over the Internet. Lab VIEW can acquire data by using DAQ. Lab VIEW includes the following tools analyze the data:

i.   Analysis Vis for differential equations, optimization, curve fitting, calculus, linear algebra, statistics, etc.
ii.   Signal processing Vis for filtering, windowing transforms, peak detection, harmonic analysis, spectrum analysis etc.

LabVIEW version 7 has introduced a new concept in interfacing- the use of assistants. The idea behind the introduction is to provide a user interactive way for development of data acquisition, instrument interfacing and code analysis. Thus the assistants provide a user friendly face to the somewhat complex task of interfacing, be it an instrument or a multifunction device. The DAQ assistant icon when placed on the diagram initializes itself and comes up with a display appropriate to the hardware installed.

LabVIEW relies on graphical symbols rather than textual language to describe programming actions. The principle of data flow, in which the functions execute only after receiving the following data, governs execution in a straightforward manner. LabVIEW programs are called virtual instruments (VIs) because their appearance and operation imitate actual instruments. However, they are analogous to main programs, functions and subroutines from popular languages like C, FORTRAN, and Pascal, etc. In LabVIEW, we can create or use "Virtual instruments" (VI) for data acquisition. A VI allows computerscreen to act as an actual laboratory instrument with characteristics tailored to particular needs. We can also use build-in examples, or use standard templates for setting up your data acquisition input channels.

8.1. Benefits of Lab View

8.1.1. Interfacing

A key benefit of LabVIEW over other development environments is the extensive support for accessing instrumentation hardware. Drivers and abstraction layers for many different types of instruments and buses are included or are available for inclusion. These present themselves as graphical nodes. The abstraction layers offer standard software interfaces to communicate with hardware devices. The provided driver interfaces save program development time. The sales pitch of National Instruments is, therefore, that even people with limited coding experience can write programs and deploy test solutions in a reduced time frame when compared to

more conventional or competing systems. A new hardware driver topology (DAQmxBase), which consists mainly of G-coded components with only a few register calls through NI Measurement Hardware DDK (Driver Development Kit) functions, provides platform independent hardware access to numerous data acquisition and instrumentation devices. The DAQmxBase driver is available for LabVIEW on Windows, Mac OS X and Linux platforms.

Although not a .NET language, Labview also offers an interface to .NET Framework assemblies, which makes it possible to use, for instances, databases and XML files in automation projects.

8.1.2. Code Compilation

In terms of performance, LabVIEW includes a compiler that produces native code for the CPU platform. The graphics code is translated into executable machine code by interpreting the syntax and by compilation. The LabVIEW syntax is strictly enforced during the editing process and compiled into the executable machine code when requested to run or upon saving. In the latter case, the executable and the source code are merged into a single file. The executable runs with the help of the LabVIEWrun-time engine, which contains some precompiled code to perform common tasks that are defined by the G language. The run-time engine reduces compile time and also provides a consistent interface to various operating systems, graphic systems, hardware components, etc. The run-time environment makes the code portable across platforms. Generally, LabVIEW code can be slower than equivalent compiled C code, although the differences often lie more with program optimization than inherent execution speed.

8.1.3. Large Libraries

Many libraries with a large number of functions for data acquisition, signal generation, mathematics, statistics, signal conditioning, analysis, etc., along with numerous graphical interface elements are provided in several LabVIEW package options. The number of advanced mathematic blocks for functions such as integration, filters, and other specialized capabilities usually associated with data capture from hardware sensors is immense. In addition, LabVIEW includes a text-based programming component called MathScript with additional functionality for signal processing, analysis and mathematics. Math Script can be integrated with graphical programming using "script nodes" and uses a syntax that is generally compatible with MATLAB.

8.1.4. Code Re-Use

The fully modular character of LabVIEW code allows code reuse without modifications: as long as the data types of input and output are consistent, two sub VIs are interchangeable.The LabVIEW Professional Development System allows creating stand-alone executables and the resultant executable can be distributed an unlimited number of times. The run-time engine and its libraries can be provided freely along with the executable.A benefit of the LabVIEW environment is the platform independent nature of the G code, which is (with the exception of a few platform-specific functions) portable between the different LabVIEW systems for different operating systems (Windows, Mac OS X and Linux). National Instruments is increasingly focusing on the capability of deploying LabVIEW code onto an increasing number of targets.

8.1.5. Parallel Programming

With LabVIEW it is very easy to program different tasks that are performed in parallel by means of multithreading. This is, for instance, easily done by drawing two or more parallel while loops. This is a great benefit for test system automation, where it is common practice to run processes like test sequencing, data recording, and hardware interfacing in parallel.

8.1.6. User Community

There is a low-cost LabVIEW Student Edition aimed at educational institutions for learning purposes. There is also an active community of LabVIEW users who communicate through several e-mail groups and Internet forums.

A VI has three main parts:

- The front panel: This is an interactive user interface of VI, so named because it can simulate the front panel of the physical instrument. Simply put, the front panel is the window through which the user interacts with the program. When we run VI we must have the front panel open such that we can input dada to the executing program. The front panel where you see your program's output. The front panel is primarily the combination of controls and indicators. Components of the front panel are controls = inputs from the user = source terminals, indicators = outputs to the user = destinations.

Figure 6: Front Panel of labVIEW software

- The block diagram: it is the Vis source code, constructed in LabVIEW's graphical programming language: G. It is the actual executable program. Subroutine in the block diagram of VI. The block diagram window holds the graphical source code of a LabVIEW VI – it is the actual executable code.
  You construct the block diagram by wiring together the objects that perform specific functions. The various components of a block diagrams are terminals, nodes, and wires.
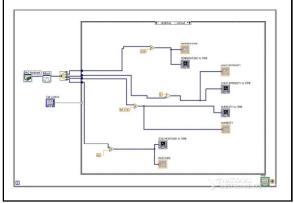

Figure 7: Block Diagram of labVIEW software

- Icons/connectors: A LabVIEW VI is held together wires connecting nodes and terminals; they deliver data from one source terminals to one or more destination terminals.

9. Result

GSM: GSM (Global System for Mobile Communications) is a global digital mobile communication system, whose coverage is the most widely and reliability is very high. SMS (Short Message Service) is a kind of short message service, by which the limited data or text message can be transmitted. A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. A GSM modem can be an external device. GSM is the most popular standard for mobile phones in the world. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. Like a GSM mobile phone, a GSM modem requires a SIM cardfrom a wireless carrier in order to operate.

- Project proposed a system through which we can measure the temperature of a human body and the humidity of a room.
- The measured values are then compared with the threshold values that are processed in the microcontroller.
- When their occurs any change the GSM get excited.
- The corresponding critical situations are messaged through the GSM to the specified number in the microcontroller program.

Figure 8: message received by mobile

9.1. Lab VIEW

A system to effectively monitor& record parameter measurements such as temperature and humidity using Lab VIEW is setup. The main advantage of the system using labVIEW is that it has high accuracy. Since the system has a simple front panel, the user can easily monitor & record the measurements. Moreover, the system is very simple as compared to other microcontroller systems.

9.2. Temperature Tab

1. Waveform Chart: TEMPERATURE Vs TIME Chart is calibrated in such a way to plot the atmospheric temperature in terms of a degree Celsius.
2. Thermometer: Thermometer is calibrated and arranged in such a way to indicate the temperature in degree Celsius as similar to the temperature indicated by mercury in thermometer.

9.3. Humidity Tab
1. Waveform Chart: RELATIVE HUMIDITY Vs TIME Chart is calibrated in such a way to plot the atmospheric humidity in terms of RH %.
2. Control Parameters panel: Control Parameters panel is designed and arranged in such a way to set the Set point humidity and to display the process variable and manipulated variable.
3. Humidity meter: Humidity meter is used to indicate the relative humidity in a calibrated scale using a needle or pointer.

10. Conclusion
In this section we have analyses the temperature and humidity monitoring system using GSM along with the interfacing of Lab VIEW. The on-line monitoring system which we have done as our mini project as a development in the hospitals. The project has wide application which is relevant in the modern society.

A throughout study has been made about wireless communication using GSM and LabVIEW. The system that we developed, can introduce any field where continuous monitoring and controlling is needed. By doing this project what we have tried to do is to make just a demo of it. The most difficult part of the project was to calibrate the sensor output. It is done to maximum possible extent. With this we are concluding this main project.

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