LAB VIEW BASED EXHALATION MONITORING SYSTEM

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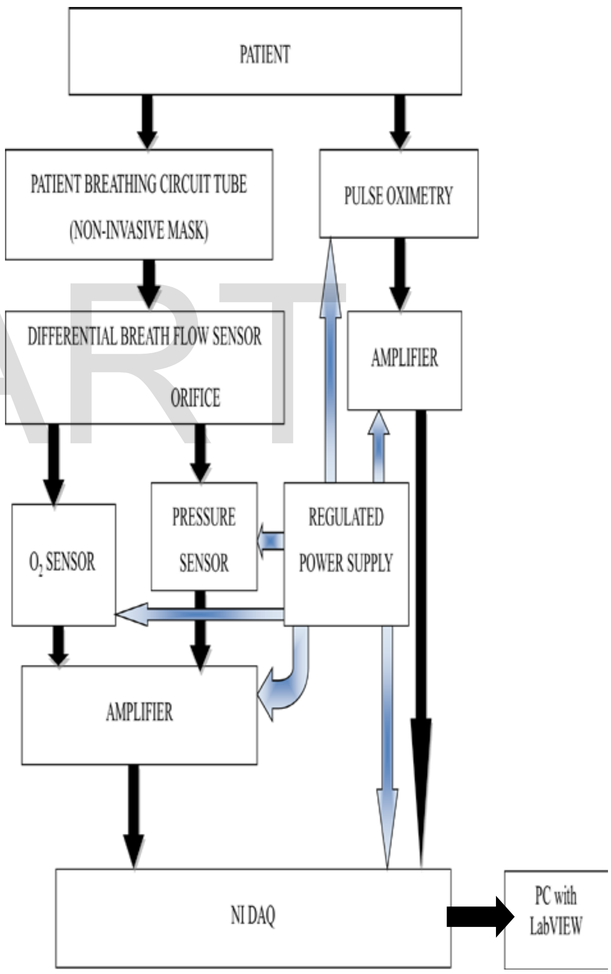
ABSTRACT

Respiration is a process in which inspiration and expiration occurs. Oxygen is both inhaled as well as exhaled along with carbon-di-oxide and other gases. During this process the percentage of Oxygen that is given out by a person is also a cause for a majority of the pulmonary diseases. The main idea of our project is to monitor the amount of oxygen expired by a patient compared to the intake and identifying the disease related to it.

The proposed project uses an O_2 sensor and a pressure sensor, which receives a signal that has to be processed from a differential breath flow sensor. The differential breath flow sensor contains an orifice which creates a difference in the pressure thus monitoring the flow rate of each breath of the subject using a pressure sensor. The O_2 sensor also gets the input from the differential breath flow sensor and it monitors the amount of oxygen inspired and expired. The net flow from the pressure sensor and the oxygen percentage from the O_2 sensor is fed to the NIDAQ as analog and digital signals and the final output is given based on comparison with the normal ranges that are stored in the database.

Keywords: O_2 sensor, NIDAQ, differential breath flow sensor, pressure sensor

PROPOSED BLOCK DIAGRAM:



SENSORS AND HARDWARE COMPONENTS INVOLVED IN EXHALATION MONITORING SYSTEM

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The patient is asked to blow into the mask through the breathing circuit, which then flows through the differential breath flow sensor. An O_2 sensor and a pressure sensor, receives the signal to be processed from a differential breath flow sensor. A pulse oximetry is used to indicate the SpO_2 concentration in blood. The outputs from the sensors and the pulse oximetry are interfaced to the PC with LabVIEW using NI DAQ where it is further analysed. The detailed descriptions of these components as shown in Figure are discussed in the following chapter.

PATIENT BREATHING CIRCUIT

The patient breathing circuit consists of the patient mask and a breathing tube that is connected to the differential breath flow sensor. The patient is asked to breathe through the mask with whatever effort is possible.

DIFFERENTIAL BREATH FLOW SENSOR

The main criterion of the design of differential breath flow sensor is to measure the presence of differential pressure as a part of flow of exhaled air indication at the input side and oxygen present in the exhaled air at the other end of the patient breathing circuit tube. The tube is of acrylic material with a covering which leads to the pressure sensor.

PRESSURE SENSOR

A pressure sensor measures pressure, typically of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical.

Pressure sensors are used for control and monitoring in thousands of everyday applications. Pressure sensors can also be used to indirectly measure other variables such as fluid/gas flow, speed, water level, and altitude. Pressure sensors can alternatively be called pressure transducers, pressure transmitters, pressure senders, pressure indicators and piezometers, manometers. Figure 2.1 shows the Pressure Sensor used in our project MPXV7002DP.This is a capacitive type pressure sensor.

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Capacitive type pressure sensor uses a diaphragm and pressure cavity to create a variable capacitor to detect strain due to applied pressure. Common technologies use metal, ceramic, and silicon diaphragms

SPECIFICATIONSOF PRESSURE SENSOR:

The MPXV7002 series piezoresistive transducers are state-of-the-art monolithic silicon pressure sensors designed for a wide range of applications, but particularly those employing a microcontroller or microprocessor with A/D inputs. This transducer combines advanced micromachining techniques, thin film metallization, and bipolar processing to provide an accurate, high level analog output signal that is proportional to the applied pressure.

- 2.5% Typical Error over +10°C to +60°C with Auto Zero
- 6.25% Maximum Error over +10°C to +60°C without Auto Zero
- Ideally Suited for Microprocessor or Microcontroller-Based Systems

Fig. Pressure Sensor -MPXV7002DP

- Thermoplastic (PPS) Surface Mount Package
- Temperature Compensated over +10° to +60°C
- Patented Silicon Shear Stress Strain Gauge

OXYGEN SENSOR

An oxygen sensor is an electronic device that measures the proportion of oxygen (O_2) in the gas or liquid being analyzed. The most common application is to measure the partial pressure of oxygen in their breathing gas.

Scientists use oxygen sensors to measure respiration or production of oxygen and use a different approach. Oxygen sensors are used in oxygen analyzers which find a lot of use in medical applications such as anaesthesia monitors, respirators and oxygen concentrators.

Fig. Medical Oxygen Sensor

Oxygen sensors are also used in hypoxic air fire prevention systems to monitor continuously the oxygen concentration inside the protected volumes. The O_2 sensor used as shown in the Figure is ENVITEC-WISMAR GMDH S.No: A185473.

AMPLIFIER

An amplifier is a device for increasing the power of a signal by using an external energy source. AD 627 is used as an amplifier for both the oxygen sensor and the pressure sensor. It delivers rail-to-rail output swing on single and dual (+2.2 V to ±18 V) supplies. The AD627 provides excellent ac and dc specifications while operating at only 85 μA maximum. With no external resistor, the AD627 is configured for a gain of 5. With an external resistor, it can be set to a gain of up to 1000. In an electronic amplifier, the input "signal" is usually a voltage or a current.

SPECIFICATIONS

- Vcc- Vee: 2.2V to 36V
- Supply Current : 0.085mA
- Bandwidth @ G=10: 30kHz
- Gain : min- 5V/V , max- 1000V/V

POWER SUPPLY

The LM1117 is a series of low dropout voltage regulators with a dropout of 1.2V at 800mA of load current. It has the same pin-out as National Semiconductor's industry standard LM317.The LM1117 is available in an adjustable version, which can set the output voltage from 1.25V to 13.8V with only two external resistors. In addition, it is also available in five fixed voltages, 1.8V, 2.5V, 2.85V, 3.3V, and 5V. The LM1117 offers current limiting and thermal shutdown. Its circuit includes a zener trimmed band gap reference to assure output voltage accuracy to within ±1%. The LM1117 series is available in SOT-223, TO-220, and TO-252 D-PAK packages. A minimum of 10μF tantalum capacitor is required at the output to improve the transient response and stability.

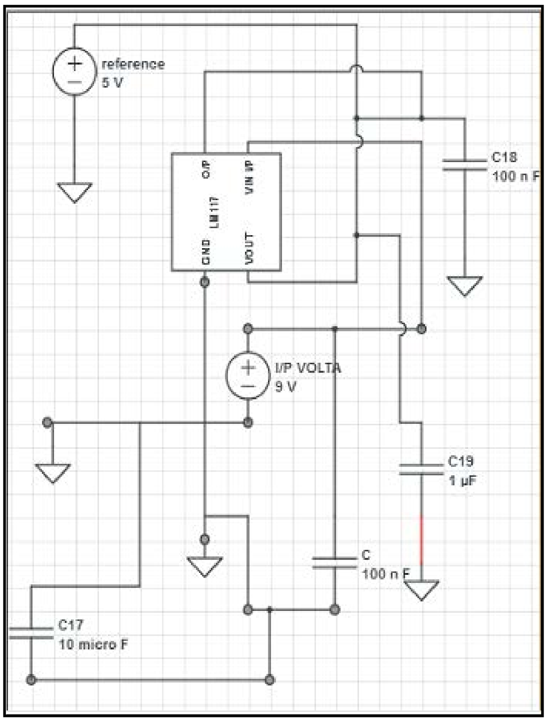

Fig. Amplifier Circuit –LM 1117

SPECIFICATIONS

- Available in 1.8V, 2.5V, 2.85V, 3.3V, 5V, and Adjustable Versions
- Space Saving SOT-223 Package
- Current Limiting and Thermal Protection
- Output Current - 800mA
- Line Regulation - 0.2% (Max)
- Load Regulation - 0.4% (Max)
- Temperature Range
  - ✓ LM1117 - 0°C to 125°C
  - ✓ LM1117I −40°C to 125°C

PULSE OXIMETRY

Pulse oximeters are medical devices that monitor the level of oxygen in a patient's blood and alert the health-care worker if oxygen levels drop below safe levels, allowing rapid intervention. These devices are essential in any setting in which a patient's blood oxygen levels requires monitoring like operations, emergency and intensive care, and treatment and recovery in hospital wards.

LM 358 is used as an amplifier in this pulse oximetry. The LM358 is a great, easy-to-use dual-channel opamp. Op amps have so many applications it should probably carry at least one in a DIP package.LM358 applications include transducer amplifiers, DC gain blocks and all the conventional opamp circuits.

FEATURES OF LM 358

- Available in 8-Bump micro SMD chip sized package, (See AN-1112)
- Internally frequency compensated for unity gain
- Large dc voltage gain: 100 dB
- Wide bandwidth (unity gain): 1 MHz (temperature compensated)
- Wide power supply range:
  - ✓ Single supply: 3V to 32V
  - ✓ or dual supplies: ±1.5V to ±16V
- Very low supply current drain (500 µA) essentially independent of supply voltage
- Low input offset voltage: 2 mV

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- Input common-mode voltage range includes ground
- Differential input voltage range equal to the power supply voltage
- Large output voltage swing

NI DAQ

Data acquisition (DAQ) is the process of measuring an electrical or physical phenomenon such as voltage, current, temperature, pressure, or sound with a computer. Data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer. Data acquisition system converts analog waveforms into digital values for processing. The components of data acquisition systems include:

- Sensors that convert physical parameters to electrical signals.
- Signal conditioning circuitry to convert sensor signals into a form that can be converted to digital values.
- Analog-to-digital converters, which convert conditioned sensor signals to digital values.

FEATURES

- Extend the Capabilities with LabVIEW and Multisim
- Compact and Portable for Use Anywhere, Anytime
- The hardware system diagram and list of Texas Instruments IC's in the DAQ user guide depicts how data converters, amplifiers, and interface and power management circuits were used in the design of NI DAQ.

SPECIFICATIONS

- 8 analog inputs (14-bit, 48 kb/s),2 analog outputs (12-bit, 150 S/s); 12 digital I/O; 32-bit counter.
- Compatible with LabVIEW, Lab Windows/CVI, and Measurement Studio for Visual Studio .NET.
- It has NI-DAQmx driver software and NI LabVIEW.

Fig. NI DAQ (USB 6009)

GRAPHICAL REPRESENTATION OF THE EXHALATION MONITORING SYSTEM

LabVIEW (**Lab**oratory **V**irtual **I**nstrumentation **E**ngineering **W**orkbench) is a platform and development environment for a visual programming language from National Instruments. The graphical language is named as "G". LabVIEW is commonly used for data acquisition, instrument control, and industrial automation on a variety of platforms including Microsoft Windows, UNIX, Linux, and Mac OS X.

The code files have the extension ".vi", which is an abbreviation for "Virtual Instrument". LabVIEW offers lots of additional Add-Ons and Toolkits.

BENEFITS OF LABVIEW

1. It provides the extensive support for accessing instrumentation hardware.
2. Real time visual debugging features
3. Built in drivers and function libraries for the serial, parallel and network computer ports.
4. Plug-and-play interface devices for external equipment.
5. Built-in interactive graphic control and display
6. Database (SQL) interfacing, libraries for industrial PLCs
7. Graphical user interface and compiled language for fast execution.

DATAFLOW PROGRAMMING

The programming language used in LabVIEW, also referred to as G, is a dataflow programming language. Execution is determined by the structure of a graphical block diagram (the LV-source code) on which the programmer connects different function-nodes by drawing wires. These wires propagate variables and node can execute all its input data.

GRAPHICAL PROGRAMMING

LabVIEW ties the creation of user interfaces called front panels. LabVIEW programs/subroutines are called virtual instruments (VIs). Each VI has three components:

- Front panel
- Block diagram
- Connector panel

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FRONT PANEL

The front panel window is the user interfac
existing VI, the front panel window of the VI appea

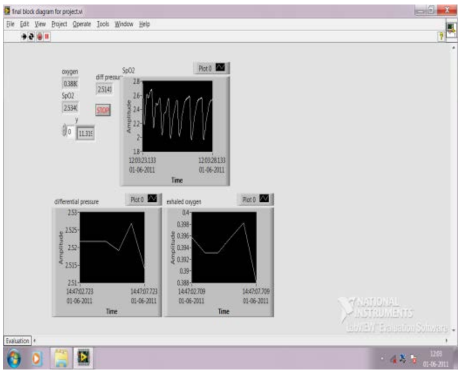

Fig. Front panel of thesystem

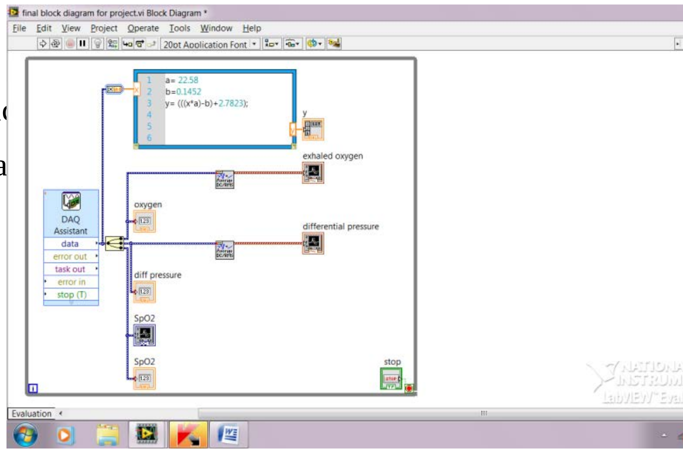

Fig. Block diagram of the

exhalation monitoring system

BLOCK DIAGRAM:

Block diagram objects include terminals, Sub VIs, functions, constants, structures, and wires, which transfer data among other block diagram objects.

A block diagram is a specialized, high-level type of flowchart. It is a useful tool both in designing new processes and in improving existing processes. In both cases the block diagram provides a quick, high-level view of the work.

conclusion:

Thus our idea of design of a Lab VIEW based exhalation system monitoring System was full filled with the above front panel and block diagram.

