

# Design and fabrication of a data logger for atmospheric pressure, temperature and relative humidity for gas-filled detector development

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## Introduction

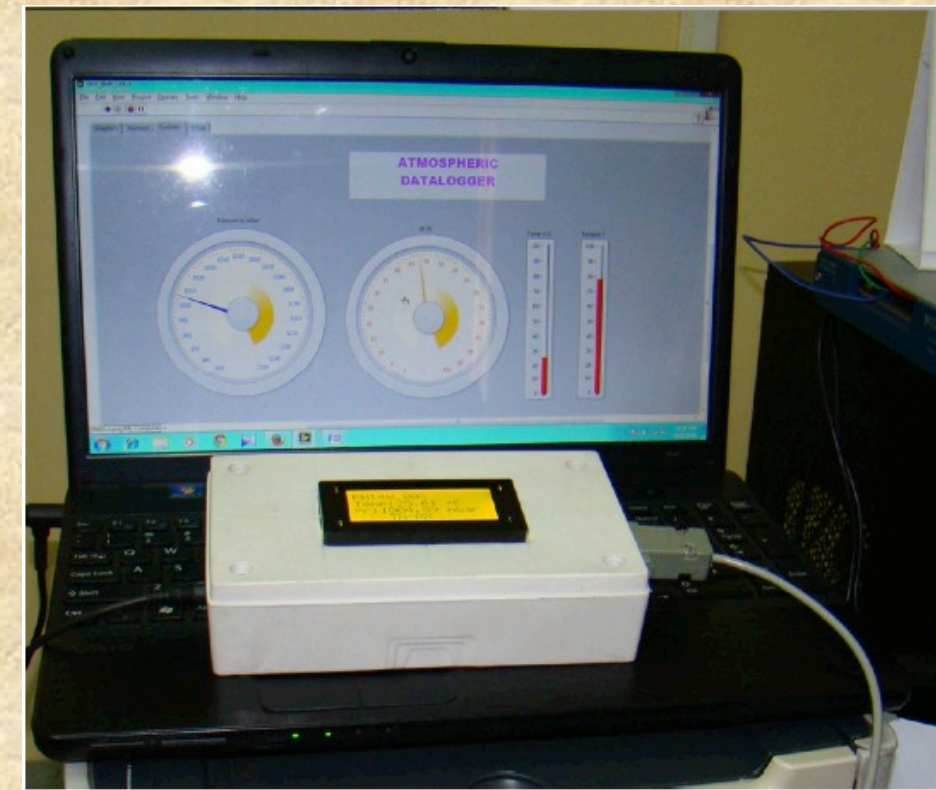
In India an initiative has been taken to build and test micro-pattern gas detector such as Gas Electron Multiplier (GEM) for several upcoming experimental High-Energy Physics (HEP) projects [1]. Temperature (t), atmospheric pressure (p) and relative humidity (RH) monitor and recording are very important for gas filled detector development [2]. The effective gain of the GEM varies with absolute temperature  $T$  ( $= t + 273$ ) in Kelvin and pressure  $p$  in atmospheric pressure as

$$G(T/p) = A e^{(B T/p)} \quad (1)$$

where, A and B are fit parameters, determined by fitting the curve of measured gain and  $T/p$  by the exponential function. Here  $t$  is expressed in °C.

The designed Data logger measures temperature, RH and atmospheric pressure. The system consists of two parts one is hardware DAQ (data acquisition) system and other is a DAQ Software. The hardware DAQ system is designed with a microcontroller based system with a 16×4 line Alphanumeric LCD display unit. The display unit updates automatically within 2-3 second interval. The interval can be made longer to about a few minutes. The hardware DAQ system has an external power port for 9V DC and RS232 communication port to PC for interfacing with Data logger software. The DAQ system transmits information with the following units, i.e. temperature in °C, RH in % and atmospheric pressure in mbar. The detail fabrication process and operation are presented here.

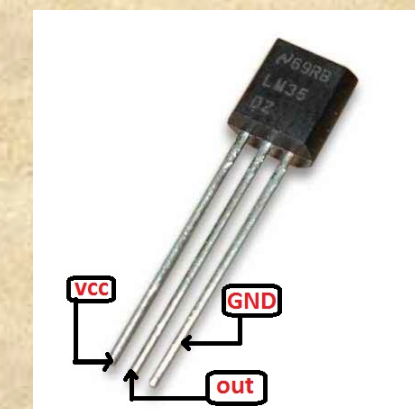
## Data logger hardware



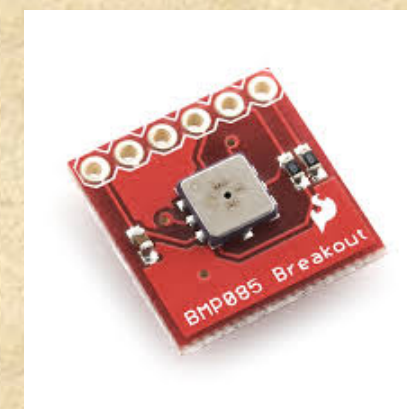
DAQ hardware



The LCD Display unit is consisting of 16×4 line Alphanumeric Display. The Display unit is Back lighted for better visibility.

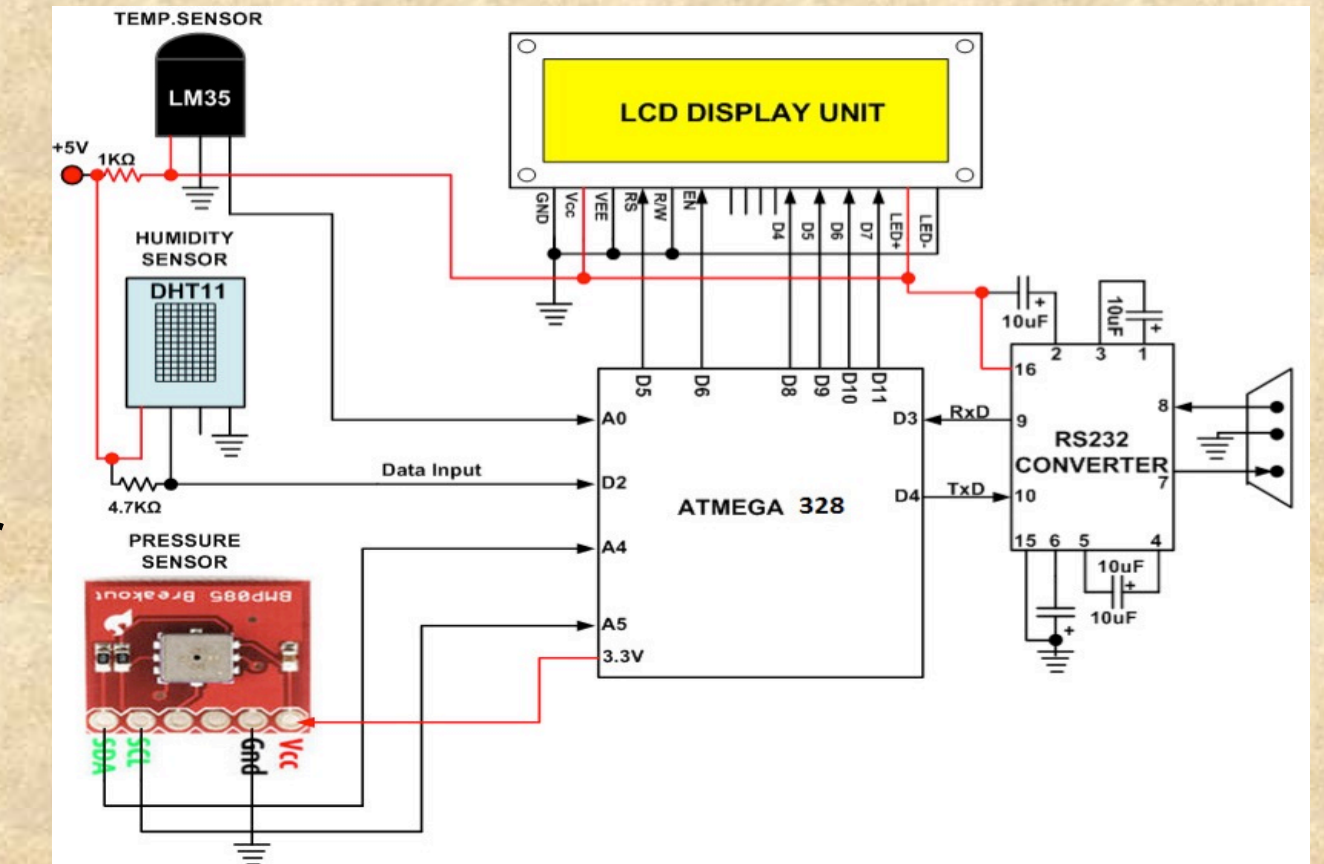


Temperature Sensor LM35



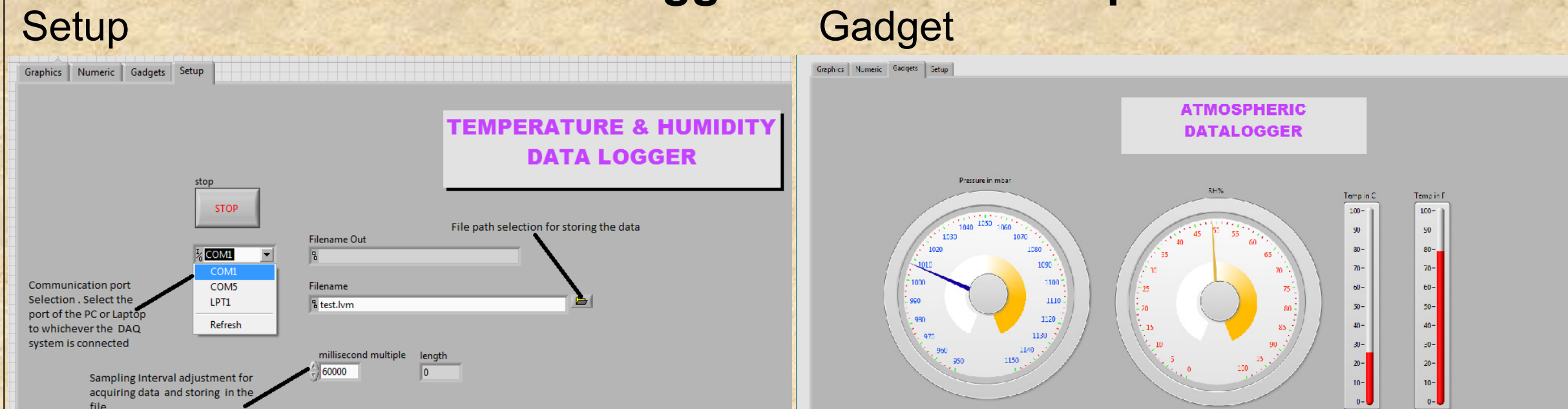
Pressure Sensor BMP085

For the Data logger the power supply specifications are as follows:  
Input Voltage 230 Volt, 50-60Hz;  
Output Voltage 9-12 V DC;  
Output Current: 500-750 mA.



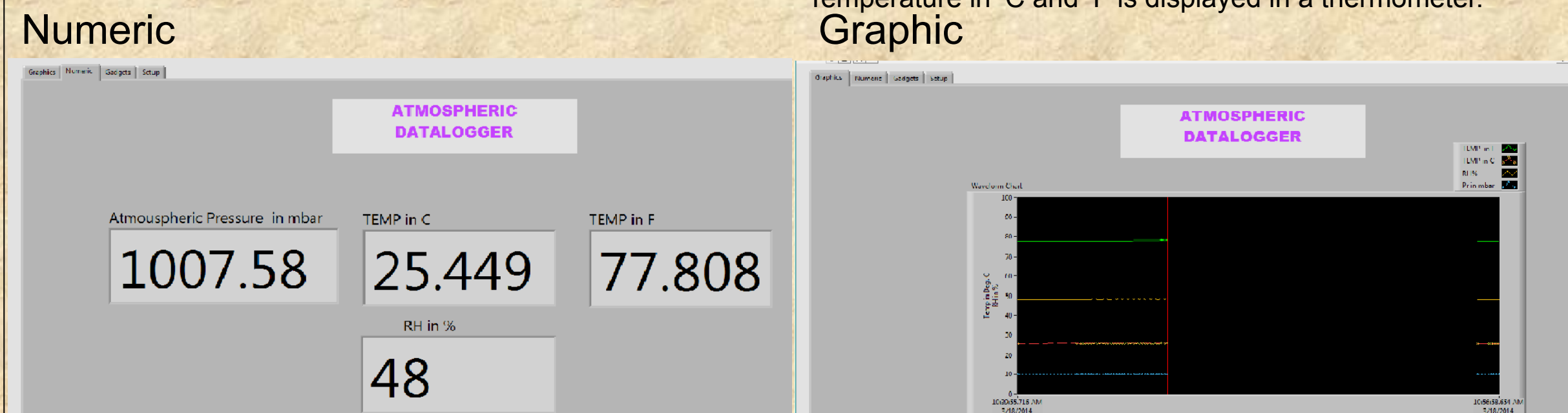
Circuit diagram

## Data logger software set-up



The setup tab

The Gadget Tab will display the Atmospheric Pressure and the Relative Humidity in two separate Dial Gauge. The Temperature in °C and °F is displayed in a thermometer.



In numeric tab all the parameters are displayed in numerical windows for example, Pressure in mbar, Relative Humidity in %, Temperature in °C and °F is displayed in Numeric windows in Decimal format.

In this Tab all the parameters Temperature in °C and °F, Relative Humidity in % and atmospheric pressure at in mbar/100 are displayed in a on line graph window with respect to time Axis.

## Features of the Data Logger

The parameters for the Data logger:

- Temperature: Measurement of temperature can be done with 0.25°C assured accuracy. The rated full range of measurement is from 0°C to 150°C. It has very low self heating with resolution ~ 0.01°C.
- RH: Measurement of RH can be done with 1% resolution and with 4% accuracy. The stability varies ±1%RH/Year and the hysteresis is 1% RH.
- Pressure: Measurement of pressure can be done with a range: 300-1100hPa (+9000 m to -500 m above sea level). Low noise: 0.06hPa (0.5m) in ultra low power mode 0.03hPa (0.25m) ultra high resolution mode < 0.1m possible with software averaging algorithm.

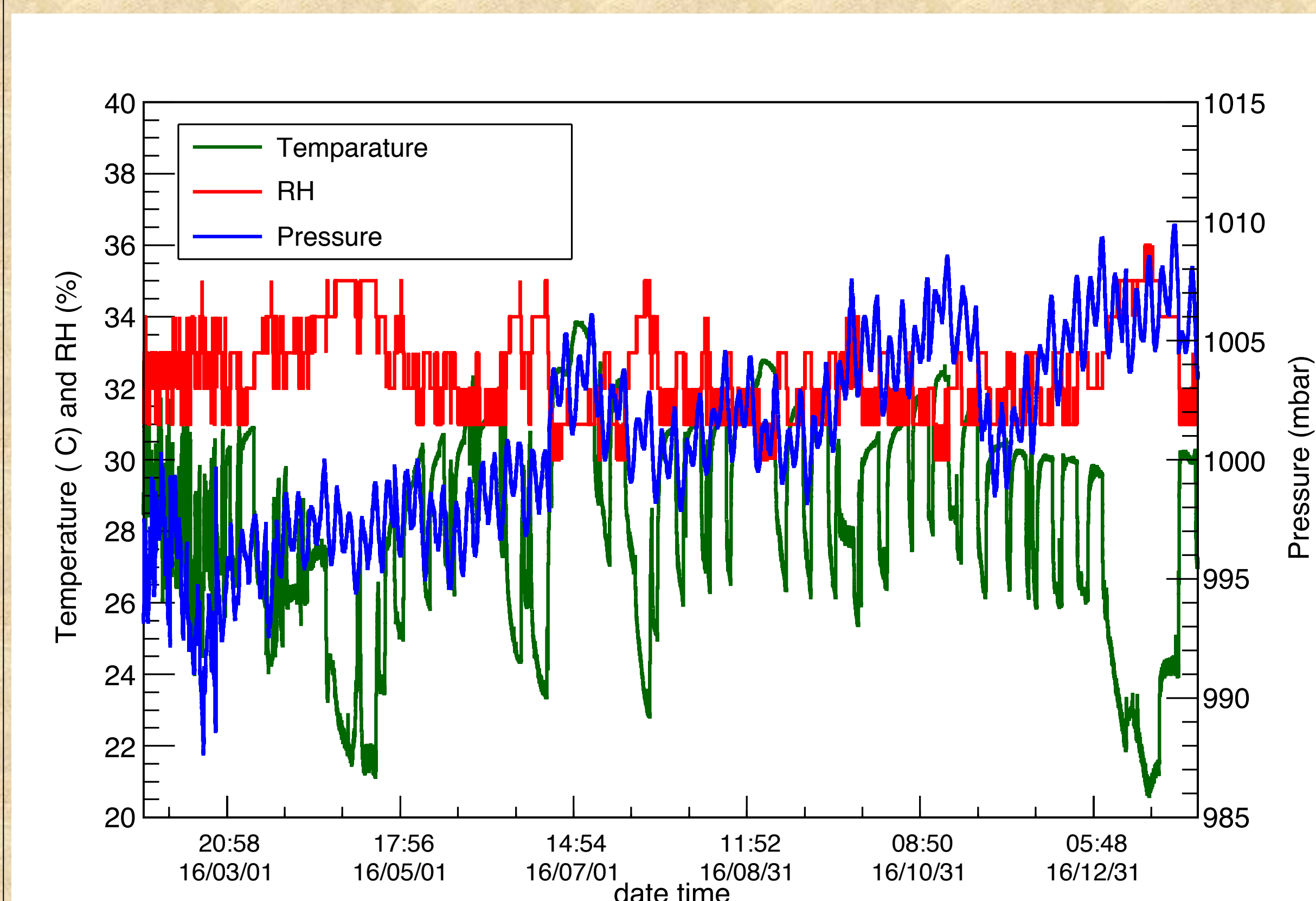
About multiple tabs in the application:

- Setup: Basically this tab is used for the user to configure the DAQ system as per the requirement.
- Gadget: In this tab the parameters are displayed in Gadgets for example, pressure and RH in two separate Dial Gauge. The temperature in °C and °F is displayed in a thermometer.
- Numeric: In Numeric Tab all the parameters are displayed in numerical windows for example, pressure in mbar, RH in %, temperature in °C and °F in decimal format.
- Graphic: In this Tab all the parameters temperature in °C or in °F, RH in % and pressure at in mbar/100 are displayed on a line graph window with respect to time axis.

The software operations:

- The communication port (COM PORT) needs to be selected properly.
- The sampling interval in msec needs to be entered by the user.
- The file path needs to be entered for data storing.

## Result



## Conclusions and outlooks

A Data logger to monitor and record the ambient parameters such as temperature, relative humidity and pressure has been developed. With this Data logger continuous recording of temperature, atmospheric pressure, relative humidity and time stamp can be done with a programmable sampling interval. This System can be accessed over LAN and Internet. All the information like RH, Temperature, Pressure are in one file. This data is necessary to correct the gain of a gas filled detector.

## Acknowledgements

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## References

- [1] Technical Design Report for the Upgrade of the ALICE Time Projection Chamber, ALICE-TDR-016, CERN-LHCC-2013-020, March 3 2014.
- [2] R. P. Adak, et al., 2016 JINST 11 T10001 doi:10.1088/1748-0221/11/10/T10001.

