Eastimation of Leak of an RPC gap by Monitoring Absolue Pressure

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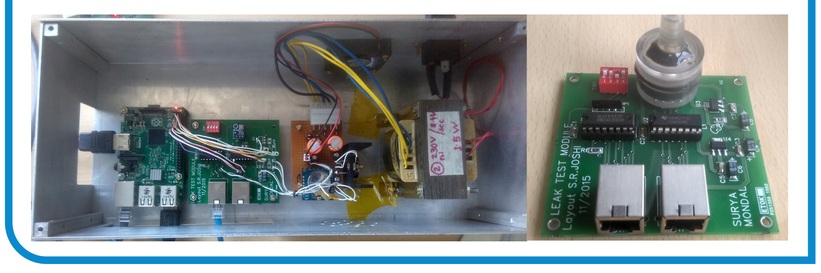
Objectives

The objective is to estimate the leak of an RPC gap by measuring the absolute (or barometric) pressure both inside and outside of the RPC gap independently using two separate pressure sensors.

1. Measure absolute pressure and temperature both inside and outside RPC gap
2. Observe the variation in pressure difference w.r.t. temperature
3. For same temperature, pressure difference should be same if no leak
4. To observe any changes in volume of RPC gap against atmospheric pressure variation
5. To detect any button pop event during the entire leak testing period
6. To develop a system to test leak for multiple RPC gap simultaneously

Leak Test Module



Results

From the plots, it is clear that the pressure inside RPC follows the trend of atmospheric pressure. And this implies that the volume of RPC changes with the change of atmospheric pressure. For this plot the changes in RPC gap volume is 1.5% with one cycle of atmospheric pressure.

The room temperature cause changes changes in the pressure inside RPC gap but the outside pressure remain unchanged. Thus, the pressure difference between inside and outside of an RPC gap depends on room temperature only. So, it is now easy to estimate leakage.

In the plot, three button-pop event can be seen at the time of pressurizing, with the sudden fall of inside pressure up to 4-5mmWC.

Future Research

A temperature controlled chamber with accuracy $\pm 0.07^{o}$C has been built to study the changes of this parameters with temperature.

- Internal Pressure
- Leakage Current
- Efficiency
- Steamer Pulse Fraction

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Introduction

The differential pressure of a conventional manometer is highly dependent on pressure of the outside atmosphere. Due to the atmospheric pressure cycle, the measurement from a manometer over a day got large variation. But the absolute pressure readings of outside and inside RPC are independent, so, the difference between these two does not depend on the outside pressure, depends on the temperature only. By monitoring the absolute pressure difference and the temperature, the leakage can be detected. During the monitoring, if there is any button-pop event, then it can be detected clearly and easily by observing the sudden fall of inside pressure.

The absolute pressure and temperature is measured by a single sensor module BMP180 manufactured by BOSCH. It is a Piezo-resistive Pressure and Temperature Sensor. The accuracy in pressure measurement is 0.7mmWC and in temperature measurement is 0.05^{o}C. The sensor module is being interfaced with I^{2}C communication method using Raspberry Pi Board.

Materials & Methods

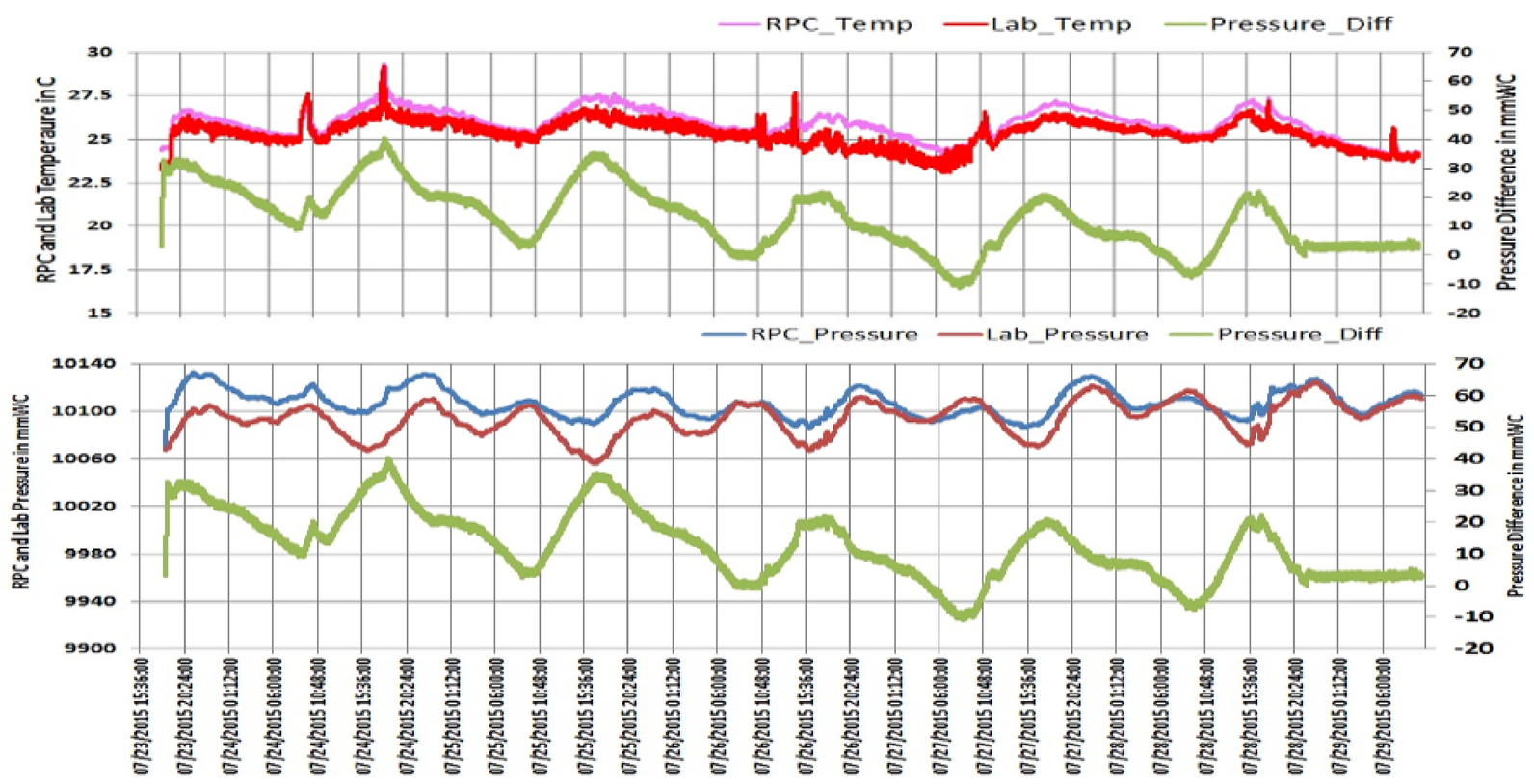
- Raspberry Pi B Board
- Leak Test Module board
- 5VDC and 9VDC supply

All the leak test modules are connected to the common bus which is a combination of Power, Data and Address lines. To avoid the drop in power supply line over long distance, 9VDC is injected at the Pi End and converted to required voltages at each test module.

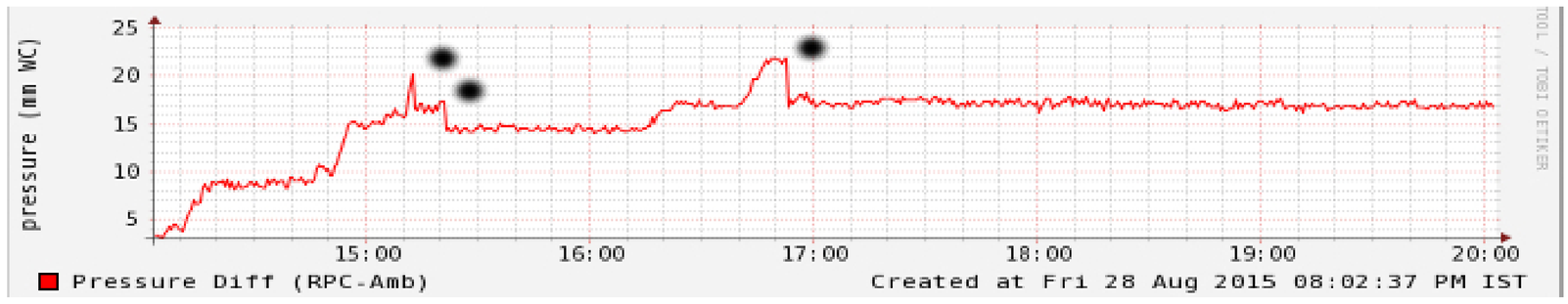
Each leak test module contains a 4-bit DIP switch, which sets the address for different RPC stations. Raspberry Pi reads values from different stations by setting 4-bit address line continuously. Depending on address lines, only one test module is allowed to write data on Data lines at a time. With 4-bit address lines, maximum fifteen RPC gap can be tested at the same time.

Each module measures the absolute pressure of different RPC and releases the data over common I^{2}C bus. This data then logged inside the memory. One sample of data can be recorded in each half second.

Leak Test Plots



Button Pop Detection



Schematic of Test Bench