Weather station

Aim:

Weather station with **pressure** reading, relative **humidity,** indoor & remote outdoor **temperature** display.

Description:

This projects is divided into 3 – modules,

1) Main unit
2) Mobile Unit
3) Sensors Unit

Both **Celsius or Fahrenheit** & **mbar/hPa or mm Hg** supported. With calendar & clock. To use 3-button user-menu. 42 hour-history display (curve). Auto-memory & display of all high and low-values.

1)Main unit:

This Unit contains LCD Display, Keypad, Alarm.

It will Read and control the data and send the data through mobile.

LCD Display : It will Display all Measurement of all data's and key inputs

Keypad: Used to get the input and control the output of this system.

Serial Communication: Which is used to send the data through mobile wireless protocols.

2)Mobile Unit:

Which is used to send all the data to PC using mobile communication.

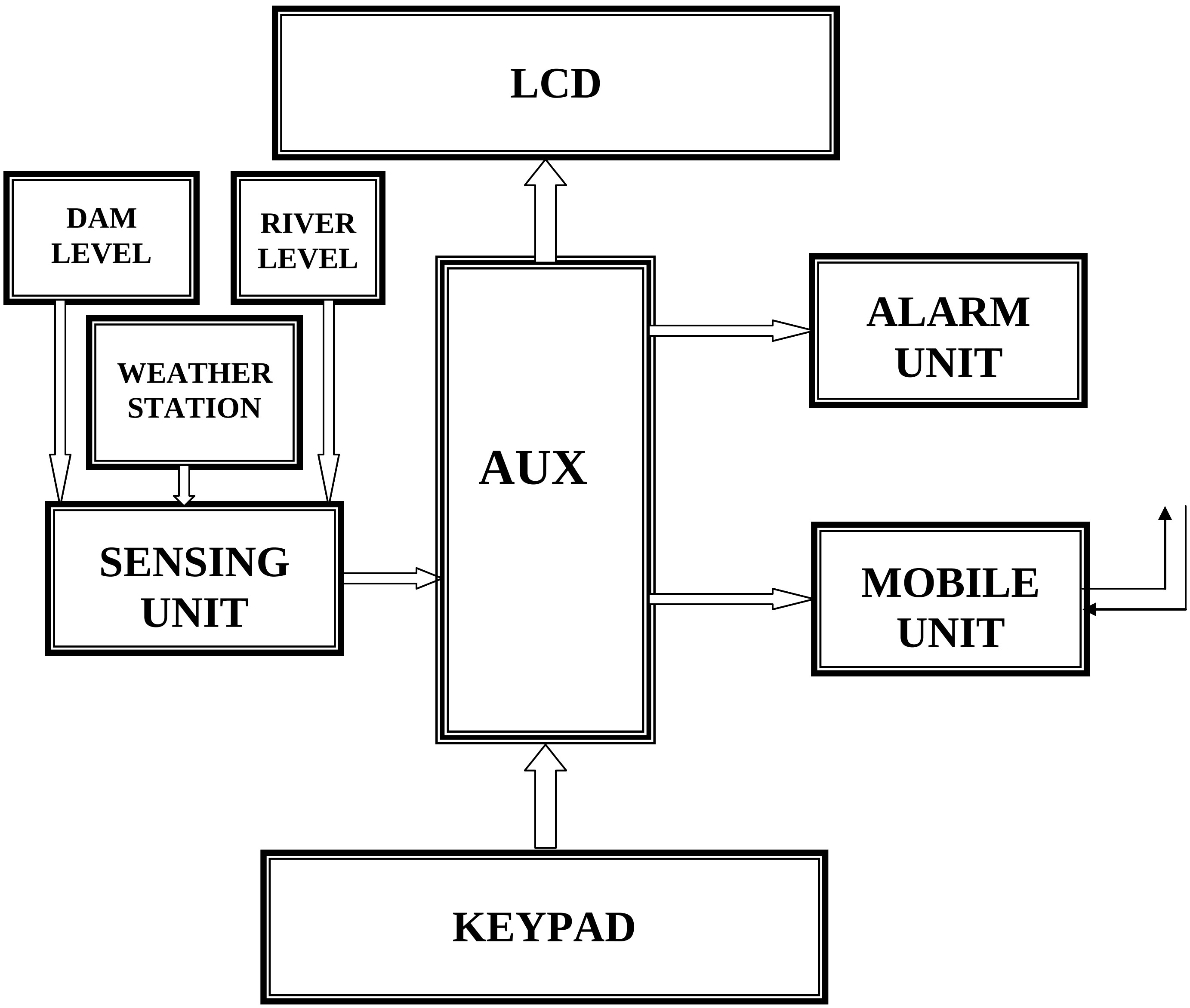
This unit having interface Hardware and wireless protocols.

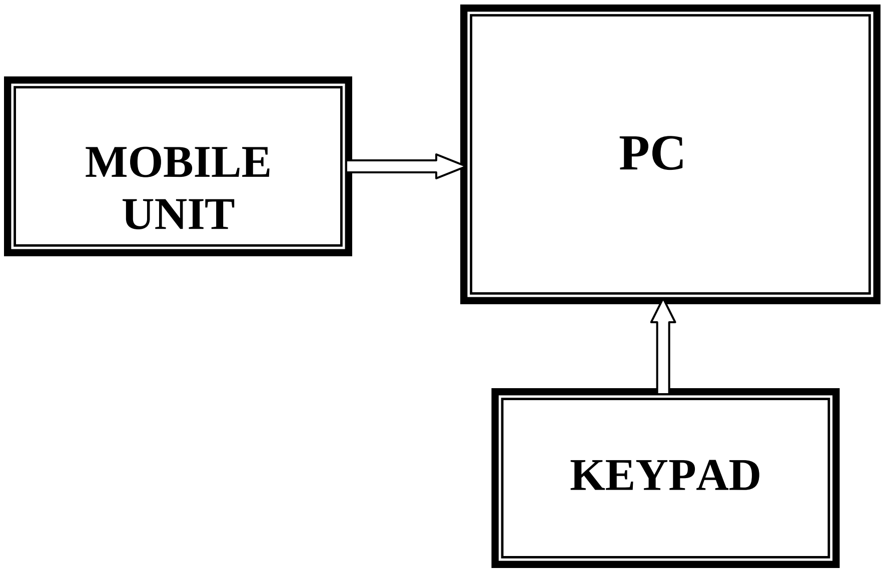
3)Sensing Unit:

This unit having 3-different type of sensing Unit,

A) Water Level measurement Sensing Units
B) River Force measurement Sensing Units
C) Weather measurement Units-

1. Temperature Sensors
2. Humidity Sensors
3. Pressure Sensors





Over view of projects:

This was a wireless communication project. The circuit may be powered by a small 9V battery, Consumption for the base station is around 8 to 9 mA whilst active and only 2 to 3 mA in sleep mode The receiver (base station) is active during 5 seconds & then goes to sleep for 45 seconds. The transmitter takes a nap every 30 seconds or so. All data is stored in EEPROM and is loaded at power-up. In case of a power failure (or when changing batteries), there will be no data (nor history) lost.

Menu mode is entered when pushing the "menu" button for 1 second. Browsing & value changes are done with the "min" & "plus" keys. When in **normal mode,** the "min" and "plus" keys can browse through the different histories. All these controls will wake up the processor if it was in **sleep mode.**

On the left-hand side of the LCD , from top to bottom, there are **Outside temperature, Pressure, Inside Temperature, Relative Humidity, Calendar and Clock.**

On the PC: **High value** of the past 42-hours, **Bar graph histogram** (right is most recent value), **Low value**.

Output of pressure sensor is an analogue voltage, which is temperature-compensated .
This analogue voltage is given to the 8051 10-bit ADC.

All the data will send to PC through mobile communication in some other place.

Aim:

This project is intended to develop the capacity of the national meteorological services by improving the observing station networks and development of human resources. The specific project components include procurement and installation of meteorological instruments and the training of staff required for manning the stations where the equipment will be deployed. The equipment will be deployed at agro-meteorological, hydro-meteorological, and synoptic stations.

(ii) Objective

To develop the capacity of the national meteorological services by improving the observing station networks, providing meteorological advisory services to the agricultural sector, and development of human resources.

(iii) Expected Output

a) Short-term rehabilitation of the Infrastructure

- Station network will be re-designed
- 3 automatic weather stations will be installed
- 3 rainfall stations will be re-equipped

b) Basic information for supporting the Agricultural Advisory Services

- Agro-meteorological bulletins are prepared and delivered every 10 days.
- Radio and TV programs to receive climate and weather information for dissemination to the public
- Sensitization workshops

(iv) Technical Description

The most critical activities for supporting PMA will be:

- Short-term rehabilitation of the Infrastructure
- Human resource development
- Basic data for supporting the Agricultural Advisory Services

a) Short-term rehabilitation of the Infrastructure

- Prepare specifications and tender for the equipment.
- Undertake pre-installation station inspection
- Prepare detailed work-plan for the field work
- Install the equipment at the selected stations
- Inspect all the stations

b) Human resource development

- Identify potential candidates
- Participate in the interview of fellows
- Carry refresher courses for class IV cadre.
- Assess performance of the fellows

c) Basic information for supporting the Agricultural Advisory Services

- Analyse decadal agro-meteorological data
- Prepare decadal, monthly and seasonal bulletins
- Co-ordinate with MAAIF officials
- Disseminate the information to end-users/farmers
- Prepare workshop materials
- Hold sensitisation workshops
- Prepare specifications and tender for the studio equipment
- Procure and install the equipment
- Prepare and broadcast weather information to end-users/farmers

(vi) Feasibility Study

N/A

(vii) Achievements

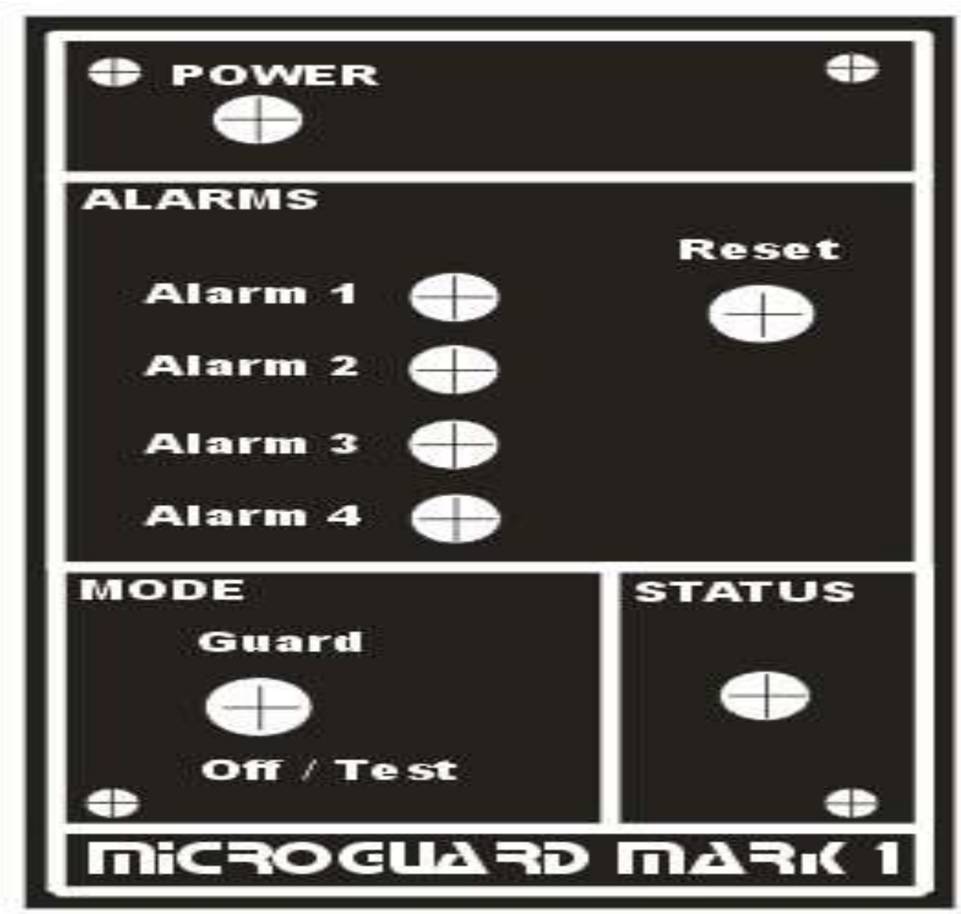
- Carried out continuous observation of national weather and atmospheric environment
- Issued warnings, information advisories to the farming community and general public
- Continued to update and upgrade the national climatic data bank
- Coordinated the UNEP Clean Development Mechanism
- Rehabilitate office buildings and upgrade the telecommunications and observing equipment at major climate station

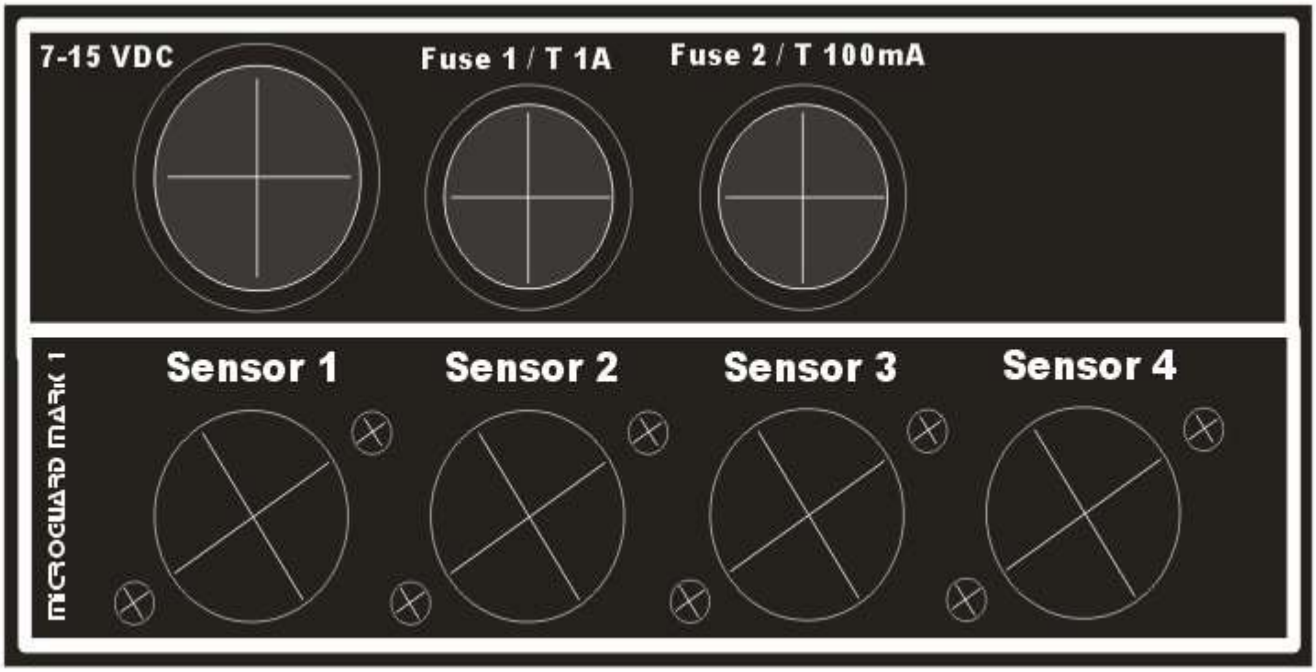
- Rehabilitation and equipping of weather observing networks.
- Manpower development.
- Sensitisation of the user communities on interpretation of weather and climate advisories.

The project has implemented signed contracts with the suppliers/manufacturers of observing equipment and contractors for renovation of some field offices. These include procurement of ten automatic weather stations and renovation of Entebbe Old Airport Upper air station to support upper air sounding launched on a daily basis to facilitate accurate preparation of briefs to aviation clients to support strategic exports and tourism. Unless meteorological services to Air Navigation are provided, Strategic Exports would be greatly undermined. The acquisition of the ten automatic weather stations is in final stages and these will constitute a system network of ten remote stations, to be located at suitable field sites throughout the country and one base station(or command station),to be located at the National Meteorological Centre, Entebbe basing on the use of GSM cellular telephone connection.

Sensitisation on the use of basic climatologically information for supporting the Agricultural Advisory Services has regularly been conducted including; frequent agro-meteorological bulletins prepared and delivered every 10 days to extension workers in all the districts, radio and TV programs to receive climate and weather information for dissemination to the public, sensitization workshops, preparing one decadal, monthly and seasonal bulletins, co-ordinating with MAAIF officials, disseminating the information to end-users/farmers, holding sensitisation workshops and preparing and broadcasting weather information to end-users/farmers.

OUT PUT DISPLAY: *Weather station*





Menu mode is entered when pushing the "menu" button (what's in a name?) for 1 second. Browsing & value changes are done with the "min" & "plus" keys. When in **normal mode** (like in the picture above), the "min" and "plus" keys can browse through the different histories. All these controls will wake up the processor if it was in **sleep mode.**

Outside temperature, Pressure, Inside Temperature, Relative Humidity, Calendar and Clock.

Output of this sensor is an analogue voltage, which is temperature-compensated! We'll feed this directly to the PIC's 10-bit ADC.
Nice SPI-sensor in a tiny SO-08 package. We'll use an emulated SPI-mode since we're already using I²C for the RTC (with a DS1307)
This sensor's output is a capacitance between 112pF (at 10% RH) and 143pF (90% RH) Its curve is not linear so we'll use a simple table to convert the A/D reading to the correct RH-value. Capacitance to frequency conversion is done with a simple 555 timing circuit. This frequency is fed to the PIC's T1_CLK.
These are cheap modules. They have a quite good range (to 25m indoors and 150m outdoors.) Data size of one packet is 32 bits. Bits 8 (LSB) to 19 (MSB) contain temperature data (BCD). Bit 21 is the minus sign, bit 23 is a low battery warning.

Receiver, calibration:

Pressure calibration	Make sure you're using a reliable multimeter, and not a cheap one. First adjust VREF- (PIC RA2, pin 4) to 2V40 with trimmer R9. Then adjust VREF+ (RA3, pin 5) to 4V70 with trimmer R8. At last, do a manual (linear) pressure correction via the menu (see below.) Of course, you'll have to know the current pressure for your area ... but this is just once!
Humidity calibration	Is done via the menu (see below). This is a one-time, linear correction.
Temperature calibration	No need, the TC77 sensors are fully calibrated.

Base station (receiver:)

Remote transmitter (outside temperature:)

H/W: AT89C51,Pic16f877,ADC0808, **Pressure calibration, Humidity calibration**

C. Embedded Systems Code

1. Remote Station

The code for the remote station is very simple and can be explained easily with psuedocode:

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 Turn Off Pressure sensor
Transmit Data
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See the Appendix for an explanation of Hamming Codes.

2. Base Station

The firmware in the base station performs the following functions

- Detect and decode data from the RF Receiver
- Perform error correction on the received data
- Encode the received data into ASCII format
- Transmit the ASCII data to the RS232 port
- Perform hourly data logging on RCVD data for a total of 24 hours of data
- Detect and respond to RS232 requests for latest and historical data

The base station firmware relies on interrupts to detect and collect incoming data as well as to maintain the one hour clock for data logging. Once these events occur, flags are set that inform the main loop that either new data is available or that it is time to store a reading in memory.

The main loop monitors the flags set by the interrupt service routine. If the Received Data flag is set, the RS232 transmitter routine is called. If the log data flag is set, the last received data block is buffered. In addition, the main loop monitors the RS232 receiver. If the character "L" is received, the last reading is transmitted to the serial port. If the character "H" is received, the last 24 hours of logged data are sent to the serial port.

The serial data is transmitted at 9600 baud using an 8N1 format. The ASCII encoded measurement data stream looks like:

T:ttt, P:ppp, H:hhh, B:bbb

In the above, T is temperature, P is pressure, H is humidity, and B is battery voltage. "ttt", "ppp", "hhh", and "bbb" are the 10 bit readings in hexadecimal format. This data has been error corrected but not calibrated. It is the function of the application software to convert the 10 bit hex values and perform the calibration corrections.

To convert the temperature and pressure, the measured voltage is the hex code multiplied by .004 or

$$Vtemp = ttt * 0.004$$

$$Vpres = ppp * 0.004$$

The conversion of battery voltage is similar:

$$Vbat = 2 * bbb * .004$$

$$= bbb * .008$$

The frequency of the humidity sensor circuit can be derived from:

$$f = 1/T = (16 * 10^6) / (hhh+2000)$$

Recall from earlier in this document that relative humidity is derived from the circuit frequency via:

$$R.H. = -6.4790E-06 * f^2 + 1.0047E-02 * f + 2.7567E+02$$

III. Calibration

A. Temperature

The temperature sensor is typically accurate to within 2ºC before calibration. To improve accuracy, you will need an extension cable between the circuit board and the sensor as well as an ice-water slurry. Place the sensor in the slurry and measure its output voltage using a voltmeter. Use the measured value in the following correction factor:

$$K=2.73/measured\_value$$

Multiply your raw A/D readings by this correction factor to improve the precision of your temperature measurements.

B. Pressure

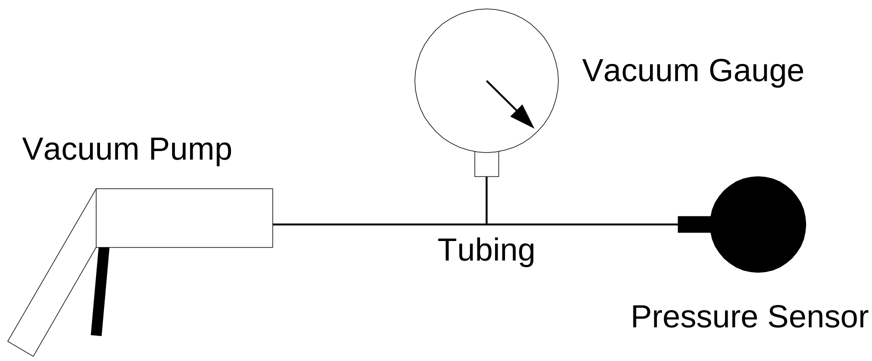
Your pressure sensor will require calibration and there are two possible methods to do it. The first method requires that you monitor your local weather channel for a couple of weeks while the second method necessitate some specialized equipment. If you choose the first method, create a table and label the first column as Pressure Sensor and the second column as actual. Next, for about two weeks, monitor and record your local weather channel for the actual pressure. At the same time, measure and record the voltage across the pressure sensor. You will need to connect the Emitter and Collector of Q1 together so that power is routed to the sensor.

Enter your data into Excel and use a linear interpolation function to derive the equation:

Actual=K*measured offset.

Use the following steps for the second method:

1. Acquire some flexible tubing, a vacuum pump (available at Pep Boys), and a manometer or vacuum gauge.
2. Again, short the emitter and collector of Q1 to provide power to the pressure sensor.
3. Record the initial voltage across the sensor as V0
4. Get the local barometric pressure (in inches of mercury – typically around 30) and record as P0
5. Connect the vacuum gauge and vacuum pump to the sensor using the following diagram:



6. Squeeze the pump until the gauge indicates a vacuum of 1" of mercury.
7. Record the voltage across the sensor as V1.
8. Perform the following calculations:

$$m = \frac{1}{V0 - V1}$$

$$b = \frac{P0 \cdot (V0 - V1)}{V0}$$

Using the above terms, barometric pressure can be calculated from the sensor voltage as:

Pressure = m * Voltage + b

C. Humidity

I found the humidity sensor to be pretty accurate and to not require calibration. However, be sure to follow the construction tips in this article to insure good performance.

Nokia 3310 GSM protocols using Fbus Protocols communication.