Electronic nose with digital sensors for pollutants detection

Jesus Lozano*[1]

[1]Universidad de Extremadura - UEx (SPAIN) – Spain

Abstract

This study addresses the development of a miniaturized wireless sensing module (electronic nose) for a personal use in air quality detection. The proposed prototype has been developed as a test device for commercial digital gas sensors (the sensors include an analogic to digital converter).

In the last years, an important evolution of gas sensors has occurred from tube-type gas sensor of the 80's (Figaro and FIS among others) with a size higher than 17mm diameter and a consumption of hundreds of mW to the latest commercial devices [1]. Nowadays, MEMS based gas sensors (Figaro TGS1800 [2], ams CCS801[3], Sgx Sensortech [4] can be found in the market with a very low size (3x4mm) and consumption (less than 15mW). Other interesting sensors for integration in small and personal measurement systems are multisensor arrays with digital communication (via I2C or SPI interface). The main purpose of this work and of the device developed is to test these devices and analyze the response obtained from the digital sensors.

The integration of this type of sensors in daily protective elements, such as respiratory masks, is necessary to have a real-time monitoring of the environment of hazardous atmospheres and thus prevent possible industrial incidents and accidents. The access to this information has to be friendly and fast, therefore the integration of monitoring devices to Internet of Things (IoT) architectures and smart devices is crucial. However, the need of a complex computational device for network communication and the necessity of a power source do limit the integration of all elements into a single protective device. Consequently, the use of cell phones into the instrumentation chain allows the miniaturization of an embedded system and its final cost, while allowing multiple bands of communication and information sharing (e.g. WiFi, Bluetooth, mobile network).

The sensor module is controlled by a microcontroller and it includes two power supplies (3.3V and 1.8V), a battery charger, a Bluetooth module and four digital sensors. It also has two UART ports (one of them to communicate to others 3.3V devices and the other one to 5V devices) and a terminal block for a solenoid valve connection. The core of the system is based on a high performance 32-bit microcontroller, model PIC32MM0256GPM048, from Microchip. It has up to 24 analog to digital (A/D) 10/12-bit input channels, 256 Kbytes of program memory, 32 Kbytes of data memory, 9 Capture/Compare/PWM (CCP) modules, 3 Inter-Integrated Circuit (I2C) modules, 3 Universal Synchronous Asynchronous Receiver Transmitter (USART) modules, and a maximum operating speed of 25 MHz.

*Speaker

The communications module is a Bluetooth 4.2 Low Energy module, the RN4871 from Microchip. Among its main features include UART Transparent Service for serial data applications, ASCII command interface API over UART and a compact form factor (9mm x 11.5 mm) with an on-board ceramic chip antenna.

The results show a reduction in the noise of the sensors and a calibration is needed to obtain good results in concentration prediction One of the sensors, Bosch BME680 [5], can measure not only gases, but also temperature, humidity and pressure. All of them convert the signals into digital data and send it to the controller. The proposed system has been tested with usual pollutants in air in order to test the performance of the system.

References

- *Suárez, J. I., Arroyo, P., Lozano, J., Herrero, J. L., & Padilla, M. (2018). Bluetooth gas sensing module combined with smartphones for air quality monitoring. Chemosphere, 205, 618-626* Figaro webpage: http://www.figarosensor.com Ams webpage: https://ams.com SGX Sensortech webpage: https://www.sgxsensortech.com
- Bosch Sensortec webpage: https://www.bosch-sensortec.com/

Keywords: electronic nose, gas sensors, air quality monitoring