

Air Quality Monitoring using Integrated Secure Wireless Sensor and Vehicular Networks

Dr. Muhammad Tahir*
&
Dr. Hafiz Malik†

*University of Engineering and Technology Lahore

†University of Michigan Dearborn

January 30, 2013



Outline

1 Introduction

- Motivation
- Architecture

2 Hardware Platform

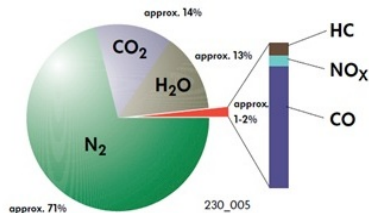
- Calibration Setup
- Data Integrity Verification
- Data Visualization
- Project Progress

3 Collaborations



Introduction

- Gas emissions from automobile engines ¹

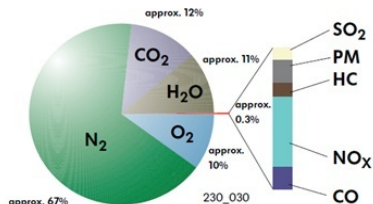
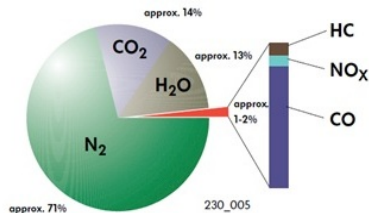


Composition of exhaust emissions of petrol engines



Introduction

● Gas emissions from automobile engines ¹

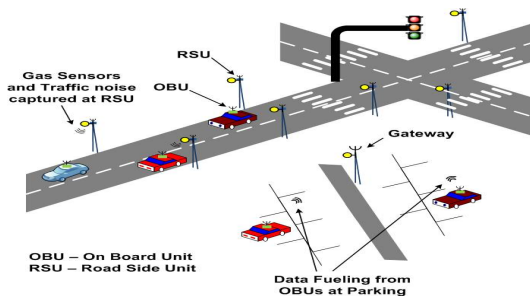


Introduction

- Monitoring of gas concentrations along the roadside
- Large number of sensing nodes required for higher spatial and temporal resolution
- Available sensing solutions:
 - *Infrared Gas Sensors*: Reference method, expensive, highly accurate
 - *Electrochemical Gas Sensors*: Non-reference method, relatively expensive, accurate, small life
 - *Semiconductor Gas Sensors*: Non-reference method, inexpensive, acceptable accuracy
- Due to low cost and acceptable accuracy, we selected Metal Oxide Semiconductor gas sensors



Architecture

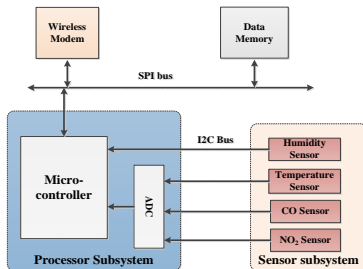


Integrated network architecture



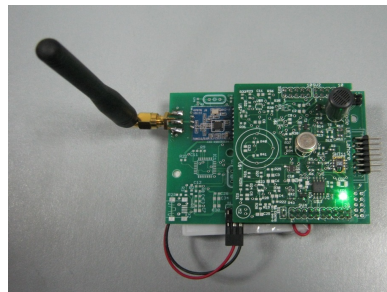
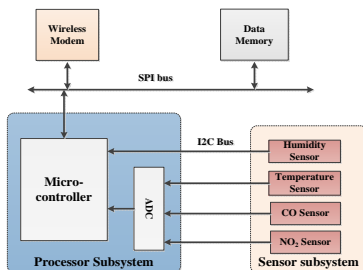
Hardware Platform

- Block diagram showing sensing, processing and communication blocks



Hardware Platform

- Block diagram showing sensing, processing and communication blocks

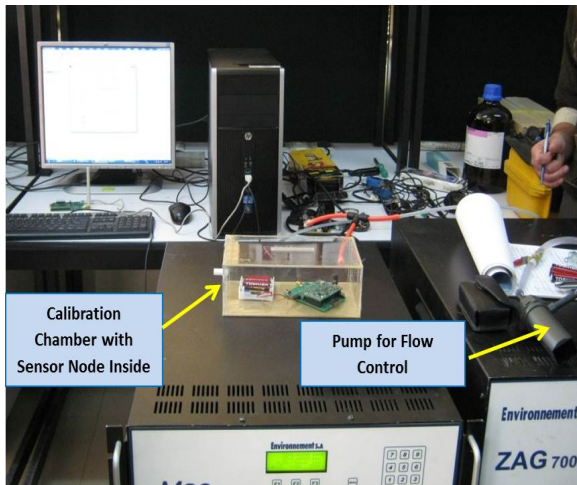


Sensor node block diagram and platform



Calibration Setup

- Calibration setup at SUPARCO.
- Calibration being carried out under controlled conditions.



DEARBORN

CO sensor calibration setup.



Data Data Integrity Verification

- An ambient sensing-centric based data integrity verification



Data Data Integrity Verification

- An ambient sensing-centric based data integrity verification
 - We propose a new research direction, which utilizes sensors and sensing technologies to provide enhanced WSN security and privacy



Data Data Integrity Verification

- An ambient sensing-centric based data integrity verification
 - We propose a new research direction, which utilizes sensors and sensing technologies to provide enhanced WSN security and privacy
 - Why sensing?



Data Data Integrity Verification

- An ambient sensing-centric based data integrity verification
 - We propose a new research direction, which utilizes sensors and sensing technologies to provide enhanced WSN security and privacy
 - Why sensing?
 - Physical attributes, sensed by sensors, reflect the current condition of the sensor or its environment



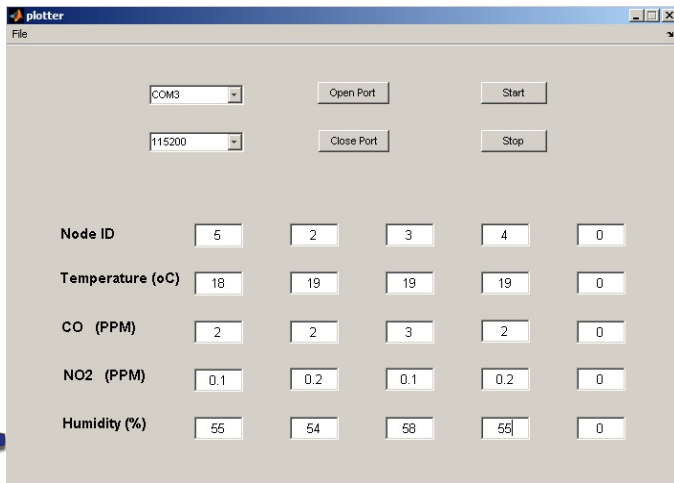
Data Data Integrity Verification

- An ambient sensing-centric based data integrity verification
 - We propose a new research direction, which utilizes sensors and sensing technologies to provide enhanced WSN security and privacy
 - Why sensing?
 - Physical attributes, sensed by sensors, reflect the current condition of the sensor or its environment
 - Temporal ambient signature can be used to for data integrity verification



Data Visualization

- A simple graphical user interface for data visualization, data storage and online accessibility



The screenshot shows a window titled 'plotter' with a 'File' menu. It contains two rows of dropdown menus for 'COM3' and '115200', and four buttons: 'Open Port', 'Close Port', 'Start', and 'Stop'. Below these is a table of sensor data with five columns and five rows of labels.

	5	2	3	4	0
Node ID	5	2	3	4	0
Temperature (oC)	18	19	19	19	0
CO (PPM)	2	2	3	2	0
NO2 (PPM)	0.1	0.2	0.1	0.2	0
Humidity (%)	55	54	58	55	0



Project Progress

- Successful design and development of more than twenty gas sensor nodes



Project Progress

- Successful design and development of more than twenty gas sensor nodes
- Currently we are preparing for field deployment of our sensor nodes



Project Progress

- Successful design and development of more than twenty gas sensor nodes
- Currently we are preparing for field deployment of our sensor nodes
- Two undergrad groups and one grad student have finished their thesis working on this project.



Collaborations

- SUPARCO has shown interest to use our solution for CH_4 and H_2S gases for industrial applications.



Collaborations

- SUPARCO has shown interest to use our solution for CH_4 and H_2S gases for industrial applications.
- We are also extending the developed solution for site monitoring and data logging for WARID telecom.



Collaborations

- SUPARCO has shown interest to use our solution for CH₄ and H₂S gases for industrial applications.
- We are also extending the developed solution for site monitoring and data logging for WARID telecom.
- The developed solution can be used for continuous monitoring of seed storage, food quality as well as for controlled agriculture.



Collaborations

- SUPARCO has shown interest to use our solution for CH₄ and H₂S gases for industrial applications.
- We are also extending the developed solution for site monitoring and data logging for WARID telecom.
- The developed solution can be used for continuous monitoring of seed storage, food quality as well as for controlled agriculture.
- The developed solution can also be integrated with existing infrastructure for automated flood forecasting etc.

