

Real Time Mapping and Monitoring of Airborne Pollution in an Urban Environment Using Autonomous Unmanned Aerial Vehicle

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Introduction: Aerial Pollution Monitoring



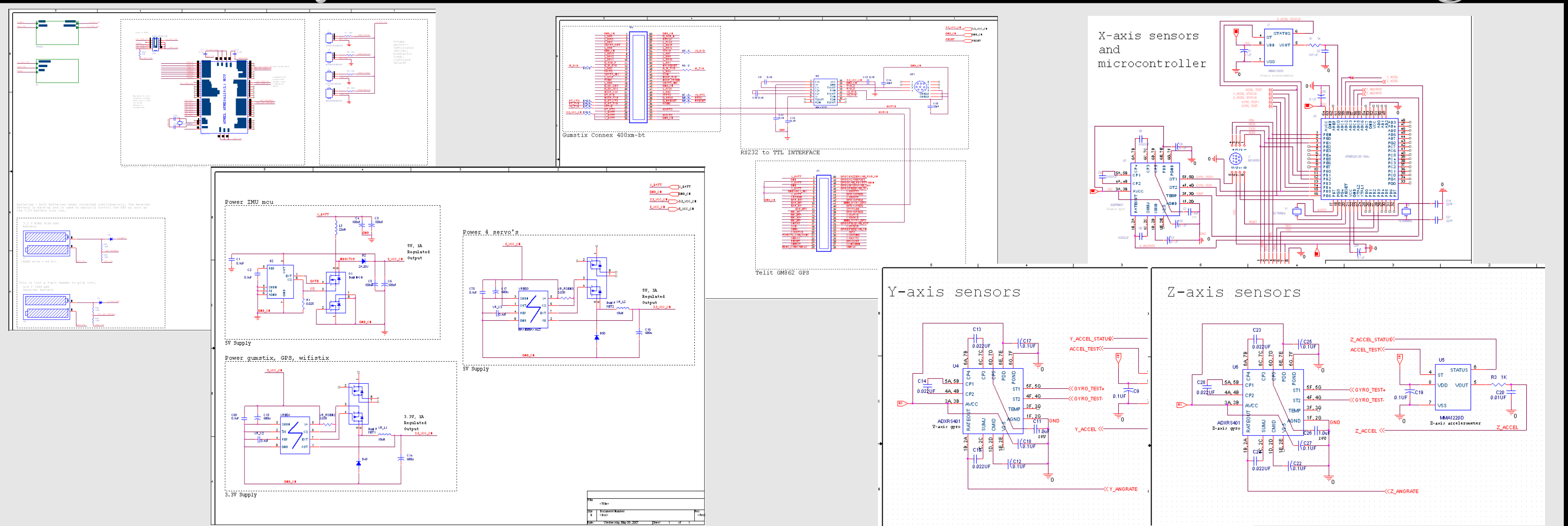
Motivation

Growing concerns about air pollution in the modern global-warming-aware world have demanded new cost-effective and low-impact methods for locating and tracking remote and mobile sources of greenhouse gases and other pollutants.

- **Aerial Pollution Mapping**
 - Real-time monitoring and modeling of pollution
 - Instant data transmission and interpretation
 - Early detection of air-quality problems
- **Unmanned Autonomous Aerial Vehicle**
 - Mobile data acquiring with rapid deployment
 - Cost effective, low-impact airplane

Problem Description: Develop Autonomous System for Environment Pollution Monitoring

- **Autonomous Aerial Vehicle Platform**
 - Light-weight, low-cost airplane capable of carrying 0.5 lb payload
 - Gumstix Connex 400xm main processor
 - Wifistix wireless communication module
 - Telit GM-862 GPS module
 - 6-channel radio
- **Autonomous Airplane Platform**
 - Mobile data acquiring with rapid deployment
 - Cost effective, low-impact airplane



Proposed Solution: Autonomous Aerial Vehicle Equipped with Pollution Sensor

Power System

- Power System consists of a 4.8V receiver battery and a main 7.2V Lithium Ion battery
- Three main switching voltage regulators:
 - 5V regulator rated at 2.5A powering four servos
 - 3.3V regulator powering flight computer, GPS module, and wireless Wifistix module
 - 5V regulator powering IMU microcontroller
- Supervisor microcontroller powered by receiver battery monitors battery voltages. In the case of the main battery voltage dropping low, the supervisor microcontroller switches to the receiver battery, signaling the flight control computer to guide the vehicle to home base.

Flight Control System

- Gumstix Connex 400xm main processor
 - 400 MHz Intel XScale® PXA255
 - 16 MB Flash Memory
 - Linux kernel 2.6.0
- Wifistix wireless communication module integrated
- Fuel-level monitoring through sensor
- Current-sensing circuitry for the four servos detects overload/jam situations

Inertial Measurement Unit

- 3-axis angular rate and acceleration measurement
- Atmega128 microcontroller integrates angular rate and acceleration to calculate short-term attitude and positional information in three dimension
- 3 single-axis ADXRS150 gyroscopes
- 3 single-axis MMA1220D accelerometers
- Modular design allows for easy mobility to other platforms
- Provides for accurate attitude correction between GPS frames

Air Pollution Sensors

- Array of low-cost gas-concentration sensors
- Detects levels of major greenhouse gases:
 - CO₂, N₂O, and CH₄



System Overview

