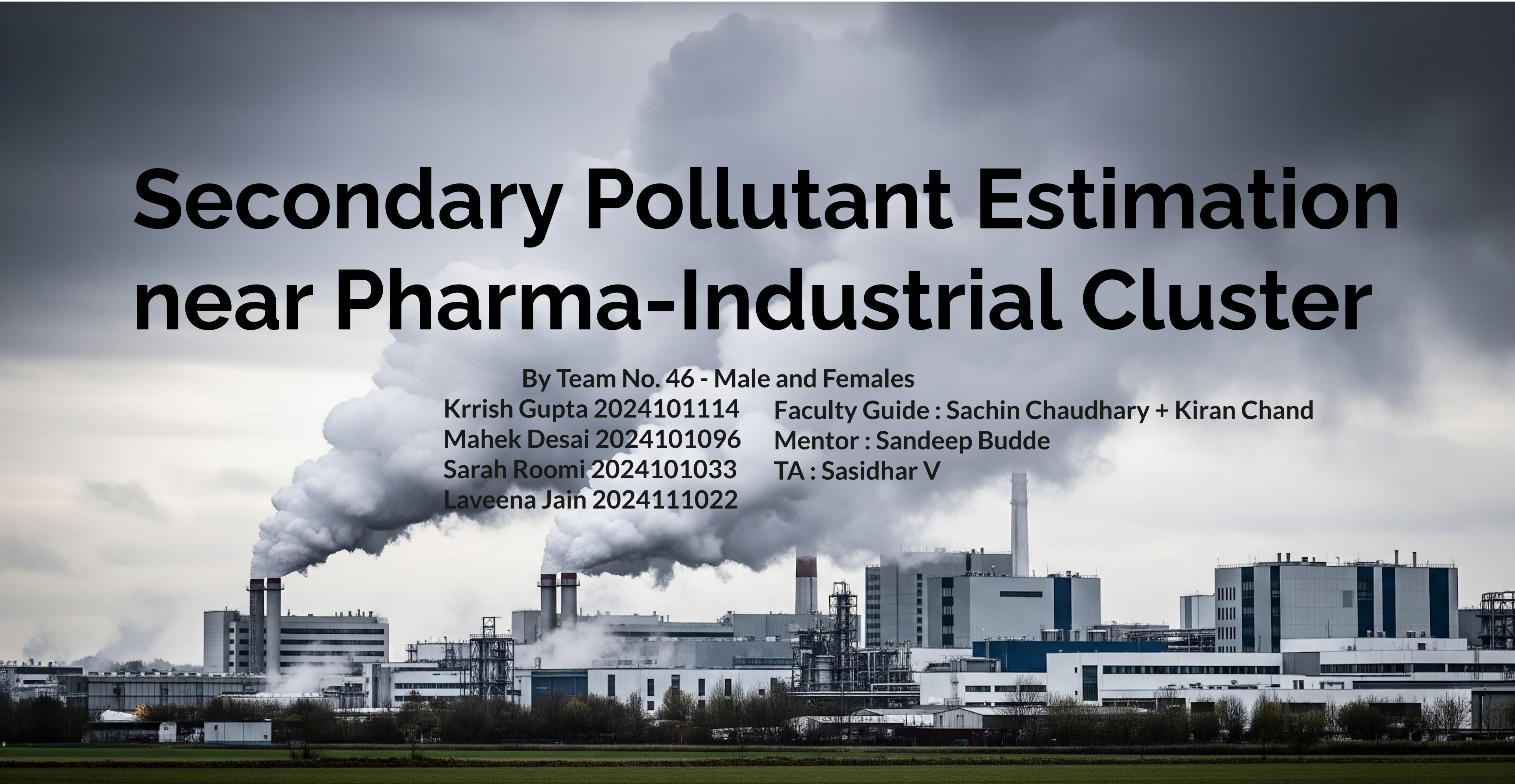


Secondary Pollutant Estimation near Pharma-Industrial Cluster

By Team No. 46 - Male and Females

Krrish Gupta 2024101114
Mahek Desai 2024101096
Sarah Roomi 2024101033
Laveena Jain 2024111022

Faculty Guide : Sachin Chaudhary + Kiran Chand
Mentor : Sandeep Budde
TA : Sasidhar V

TOC

Motivation

Hyderabad's pharmaceutical industry is a major source of precursor emissions that form toxic secondary pollutants like ground-level ozone and fine particulate matter (PM2.5) in the atmosphere.

Our motivation is to quantify this real-world danger. While regulations focus on emissions at the factory, the severe health impacts on nearby communities are caused by these secondary pollutants in the air they breathe. This project will explore this under-studied field of secondary pollutants and try to create models to estimate their formation at various heights.

Research inspirations

- Secondary pollutants - https://web.iitd.ac.in/~arunku/files/CVL313_Y20/Secondary%20pollutantsharrison1986.pdf
- Potential Estimation of Secondary Pollutant Formation of BVOC from Peltophorum pterocarpum in Urban Area
- Hyderabad's pharmaceutical pollution crisis: Heavy metal and solvent contamination at factories in a major Indian drug manufacturing hub

7 Secondary pollutants*

Introduction

Secondary pollutants such as ozone, PAN, and aerosols are formed when primary pollutants (PM, CO2, VOCs, Nox) from industrial emissions during late nights undergo photochemical reactions in the presence of sunlight. Their concentration can vary with height due to changes in solar radiation and atmospheric dispersion.

Overview

1. Estimation of formation rates of secondary pollutants at different heights and times of day and create a dashboard.
2. Using a regression model and chemical kinetics concepts to estimate the production of ozone.
3. Incorporate temperature, humidity and pressure data from weather forecasts for analysis.
4. Measure primary pollutants like NOx, VOCs, and PM.

Project Goals

- We plan to measure primary pollutants (NOx, VOCs, PM), secondary pollutants (Ozone, aerosols) via sensors and gather meteorological data from external sources.
- PAN sensors are incredibly expensive and there are no low cost alternatives. Hence we plan to estimate PAN concentration through analysis of chemical equations.
- Moreover, we are also using a UV intensity sensor to analyse the sunlight intensity and its correlation with production of secondary pollutants.
- We will also be using a regression model to estimate ozone levels.
- We will be creating a dashboard that consists of various analytical graphs, (Eg: Ozone levels throughout the day).

Components Required

- ESP32
- GSM Module - For Cellular Connection
- SGP40
    - Buy Online
    - Cost - 1473
    - Measures VOCs
- MQ131
    - Buy Online
    - Cost - 1492
    - Measures concentration of Ozone
- MiCS-2714
    - Buy Online
    - Cost - 969
    - Measures concentration of NOx

Component	Price
ESP-32(40 pin)	590
RTC module with battery	232
VOC sensor(SGP40)	1473
Ozone sensor(MQ131)	1492
NOx sensor(MiCS-2714)	969
PM sensor(SDS011)	2071
UV ray intensity sensor	232
Micro SD card module	39
Micro SD card 32 GB	479
AC to DC converter (SMPS) power sepcs	227
BMS module	99
Booster	39
Lithium Ion battery	166
Battery holder	30
IN5822 dioodes (2)	10
IP65 box	250
TOTAL PRICE:	**8398**

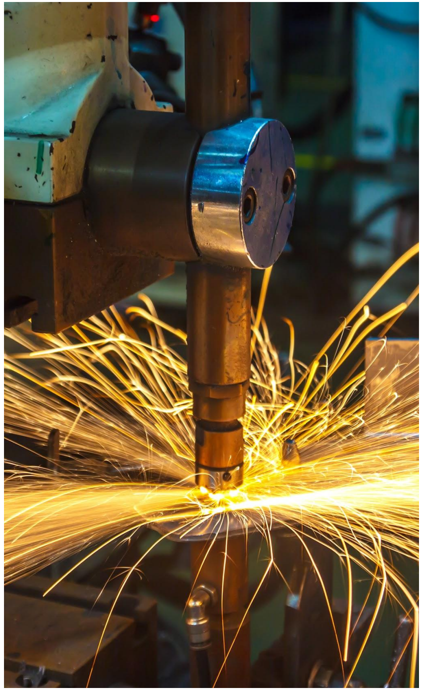
Components Required

- PM5003
    - [Buy Online]
    - Cost - 1700
    - Measures PM2.5 and PM10
    -
- UV Ray Intensity Sensor
    - [Buy Online]
    - Cost - 232
- AC to DC converter
- Micro SD Card Module
    - [Buy Online]
    - Cost - 39
- Micro SD card

21		
22		
23	Camera	3663
24	Raspberry Pi 3 + power supply + sd card	4949
25	IP65 box	250
26	TOTAL PRICE:	**8862**
27		
28	Jumper wires	
29	Breadboard	
30	Resistors	
31	Capacitors	
32	Single layred Zero PCB	
33	USB Cable(Type-B)	
34	Soldering Iron	
35	Solder	
36	Screws & Nuts	
37	Toolkit	
38	ACwire +AC Plug	

Components Required

- BMS module
    - Buy Online
    - Cost - 99
    - To manage charging of rechargeable battery and powering the ESP32
- Booster (3.3V to 5V)
    - Buy Online
    - Cost - 39
- 3.3V Rechargeable Lithium ion battery
    -



Components (Cont.)

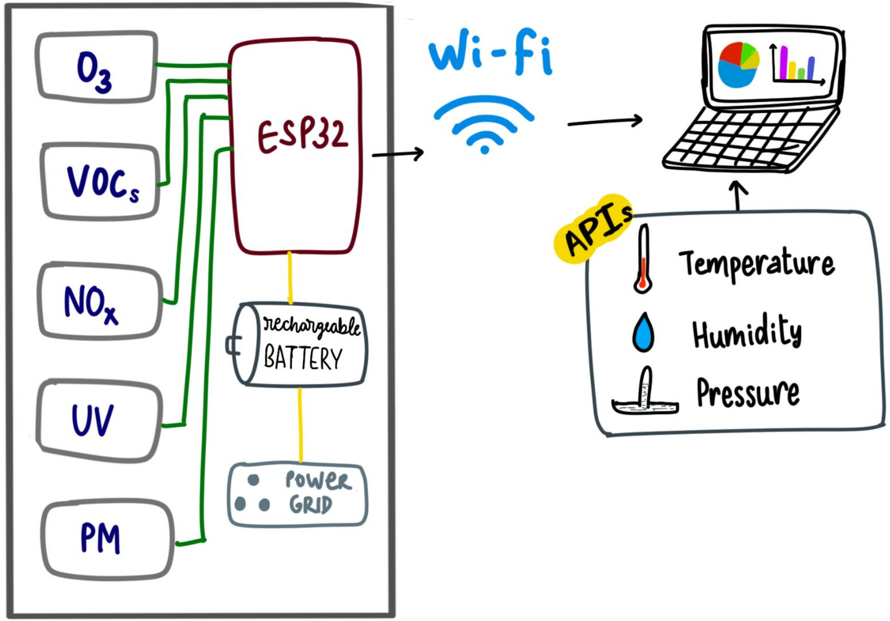
01 Measures PM2.5 and PM10 particulate matter

02 Micro SD card for data storage

03 UV Ray Intensity Sensor for sunlight analysis

04 AC to DC converter and Micro SD Card module

Block architecture of the hardware



Data Collection Plan and Communication

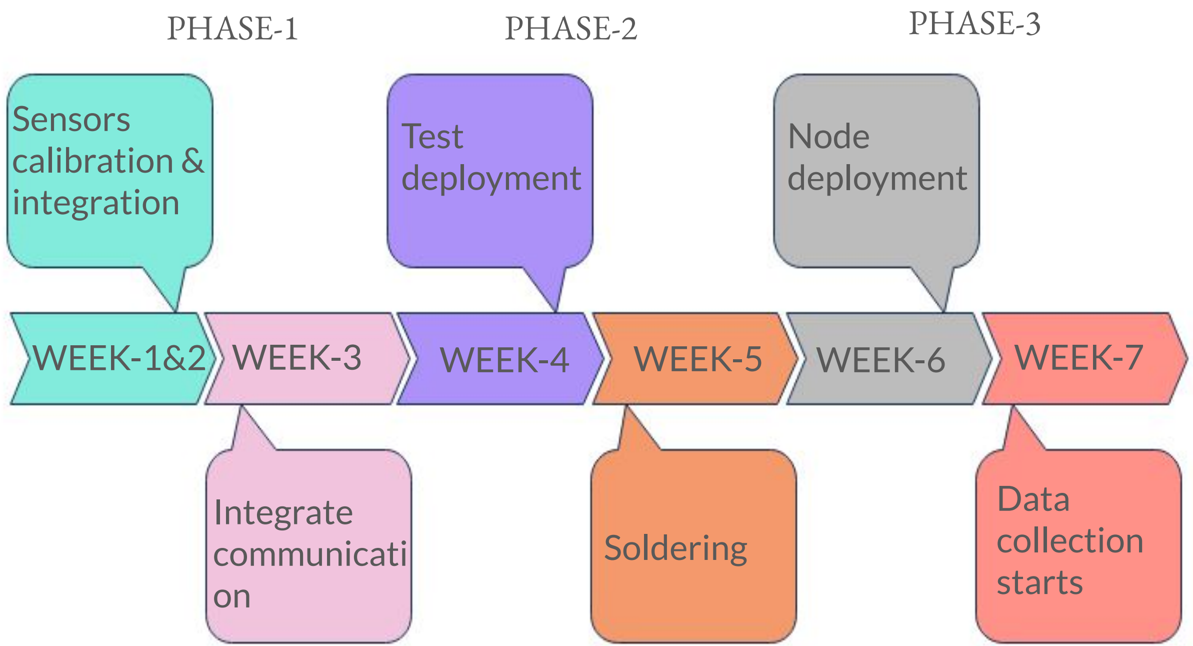
01 | **Deployment:** A single sensor node will be deployed in 3-4 day cycles at varying altitudes to perform vertical pollutant profiling.

02 | **Data collection strategy:**

- **Sample frequently:** Wake the ESP32 every 1 minute(tentative, depends on the rate of data change) to take a sensor reading.
- **Store individually:** Save each 1-minute reading to the ESP32's RTC memory and immediately return to deep sleep.
- **Transmit in a batch:** After 15 minutes, wake the system fully, package all 15 individual readings into a single JSON array, connect to the cellular network, and transmit the entire batch.

03 | **Communication:** Data will be transmitted over a 4G cellular network, following the oneM2M communication standard

Timeline


PHASE-1
PHASE-2
PHASE-3
Sensors calibration & integration
Test deployment
Node deployment
WEEK-1&2
WEEK-3
WEEK-4
WEEK-5
WEEK-6
WEEK-7
Integrate communicati on
Soldering
Data collection starts

Future Extensions

- Camera with ML integration
- Analysing spatial dispersion of gases
- Creating a drone-based model
- Vertical profiling of secondary gases

Links:

Task Sheet: Link1

Research and Relevant material: Link2

Sensor Working and Purpose: sensor working and purpose - Google Docs

Thank you.