Breath Sense — AQI 24h Predictor & Health Impact Score

Breath Sense is a **desktop-based Python application** that predicts **next 24-hour Air Quality Index (AQI)** and computes a **personalized Health Impact Score (HIS)** using **Machine Learning** and **real-time API data**. It features a **modern PySide6 GUI**, supports **CSV-based ML forecasts**, and optional **OpenWeather API-based forecasts**.

Features

- **24-hour AQI Forecast** (hourly)
- **Machine Learning–based prediction** using trained .pkl model
- **Live AQI forecast via OpenWeather API** (PM2.5)
- **Personalized Health Impact Score (0–100)** based on:
    - AQI exposure
    - Breathing rate
    - Outdoor exposure hours
    - Mask type (None / Cloth / Surgical / N95)
- Interactive dashboard with:
    - Current AQI
    - Peak AQI
    - Average AQI
    - Health Score
- Export predictions to **CSV**
- Modern dark-themed GUI (PySide6)

📁 **Project Structure**

BreathSense/

```
│
├── aqi_gui3.py              # Main GUI application
├── aqi_model.pkl            # Trained ML model (required for ML mode)
├── aqi_model.py             # Model utilities (load, forecast, config)
├── AQI_24h_Predictor_and_HealthScore_UPGRADED_ML.ipynb
│                            # Model training & experimentation notebook
```

```
├── your_dataset.csv          # Historical AQI CSV used for training
├── requirements.txt          # (Optional) dependency list
└── README.md                 # This file
```

How It Works

ML Forecast Mode

- Uses a **trained ML model (aqi_model.pkl)**
- Requires the **same CSV structure** used during training
- Predicts **PM2.5 → AQI → Health Score** for the next 24 hours

API Forecast Mode

- Uses **OpenWeather Air Pollution Forecast API**
- Fetches **real-time PM2.5 forecast** based on city location
- Converts PM2.5 → AQI (US EPA standard)
- Computes Health Impact Score

You can switch between **ML Forecast** and **API Forecast** from the UI.

Requirements

Make sure Python **3.9 or later** is installed.

Required Python Libraries

pip install numpy pandas requests PySide6 scikit-learn joblib

All required libraries are already installed in the developer's system. Install them if running on a new machine.

OpenWeather API Key (Optional but Recommended)

To enable **API Forecast mode**, get a free API key from OpenWeather:

- https://openweathermap.org/api

Set API Key (Recommended Method)

Windows (PowerShell)

set OPENWEATHER_API_KEY "your_api_key_here"

Linux / macOS

export OPENWEATHER_API_KEY = your_api_key_here

Alternatively, you can **paste the API key directly into the GUI input field**.

How to Run

Step 1: Clone Repository

git clone https://github.com/your-username/breath-sense.git

cd breath-sense

Step 2: Run the Application

Run this command “python aqi_gui3.py” in your command prompt in the same folder.

Using ML Forecast Mode

1. Click **"Load ML"**
2. Ensure aqi_model.pkl exists in the same directory
3. Select the **CSV file used during training**
    - Column names must match training data
    - Extra spaces in headers are auto-handled
4. Click **"Predict"**

Using API Forecast Mode

1. Enter **City Name** (autocomplete supported)
2. Enter **OpenWeather API Key**
3. Select **API forecast** from dropdown
4. Click **"Predict"**

Health Impact Score (HIS)

- Range: **0 to 100**
- Higher score = healthier air exposure
- Uses a **non-linear decay model** to avoid sudden zero scores

Factors Considered

Factor	Description
AQI	Air Quality Index
Breathing Rate	Liters/minute
Outdoor Hours	Exposure duration
Mask Type	Exposure reduction factor

Export Results

Click **"Save CSV"** to export:

- ML AQI & HIS
- API AQI & HIS (if available)
- Hourly predictions (24 rows)

🛠 Troubleshooting

Issue: ML mode disabled

- Ensure aqi_model.py and required ML libraries exist

Issue: Column mismatch error

- Use the same CSV format as training
- Column names are case-sensitive (spaces are auto-trimmed)

Issue: API not working

- Check API key validity
- Ensure city name is valid

Notes

- Designed for **research, learning, and demonstration** purposes
- AQI values follow **US EPA PM2.5 standards**
- Health Score is **indicative**, not medical advice

License

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Output:-