🚗 Vehicle Monitoring AI - User Guide

Welcome to the Vehicle Monitoring AI system! This guide will help you set up, run, and use the system to monitor vehicles, read number plates, detect colors, and interact with the system via chat commands.

📋 Requirements

- Python 3.8+
- Virtual environment (recommended)
- Installed dependencies (see `requirements.txt`)
- YOLOv8 model weights (`yolov8n.pt` or `yolov8x.pt`) downloaded and placed in the project root
- Sample videos or your own video feeds for testing

⚙️ Setup Instructions

Clone the repository
bash
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```
git clone https://github.com/yourusername/vehicle-monitoring-ai.git
cd vehicle-monitoring-ai
```

1.
2. **Create and activate a virtual environment**

On macOS/Linux:
bash
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```
python3 -m venv venv
source venv/bin/activate
```

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On Windows:
bash
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```
python -m venv venv
venv\Scripts\activate
```

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Install dependencies
bash
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```
pip install -r requirements.txt
```

3.
4. **Download YOLOv8 model weights**
   Download `yolov8n.pt` or `yolov8x.pt` from:
   - Ultralytics YOLOv8 GitHub
   - Or any provided Google Drive link
5. Place the `.pt` file in the root folder of the project.

▶️ Running the System

1. Run the video processing pipeline for vehicle detection, plate OCR, and color detection

bash
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```
python pipeline/runner.py
```

- This processes sample videos (`sample_videos/cam1.mp4` and `cam2.mp4`) by default.
- It runs multi-process parallel detection per camera.
- Detection results are stored in an SQLite database.

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2. Start the chat command interface (Streamlit UI)

In a new terminal (with virtualenv activated), run:

bash
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```
streamlit run ui/chat_input_streamlit.py
```

A web UI will open where you can enter chat commands like:
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```
Track black car RJ14AB1234
Show all white cars
```

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- The UI will show the latest matching vehicle detections from the database.

📝 Supported Chat Commands

- `track <color> car <number_plate>`
- `show <color> cars`
- `find <number_plate>`
- Colors supported: black, white, gray, red, orange, yellow, green, blue, brown

Example commands:

- `Track red car RJ14AB1234`
- `Show all white cars`
- `Find blue car MH12DE3456`

🗂️ Project Structure Overview

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```
vehicle_monitoring/
├── pipeline/               # Video processing pipeline with multiprocessing
├── detection/              # YOLOv8 vehicle detection code
├── color_detection/        # HSV-based vehicle color detection
├── ocr/                    # Number plate OCR using EasyOCR
├── chat/                   # Chat command parser and query state manager
├── storage/                # SQLite DB handling vehicle detections
├── ui/                     # Streamlit chat UI
├── sample_videos/          # Sample input videos for testing
├── yolov8n.pt              # YOLOv8 model weights (not included)
├── requirements.txt        # Python dependencies
└── README.md               # Project documentation
```

🔧 How It Works (High-Level)

1. **Video frames** from each camera feed are processed in parallel.

2. **YOLOv8** detects vehicles and extracts bounding boxes.
3. Vehicle crops are processed to detect **dominant color**.
4. Number plates are cropped, preprocessed, and fed to **EasyOCR** for text.
5. Detections are saved to the SQLite database.
6. The **chat command parser** reads user input from the UI.
7. User queries are matched to detections in the database.
8. The UI displays matching vehicles live.

🛑 Troubleshooting

- **No vehicles detected?**
  - Check if YOLOv8 weights (`.pt` file) are in the root directory.
  - Ensure sample videos exist in `sample_videos/`.
  - Check terminal logs for errors.
- **EasyOCR not working or slow?**
  - Ensure `easyocr` is installed properly.
  - Running on GPU is faster, but CPU works too.
- **Streamlit UI does not open?**
  - Make sure Streamlit is installed (`pip install streamlit`).
  - Use the command: `streamlit run ui/chat_input_streamlit.py`.
- **Database errors?**
  - The SQLite DB is stored in `storage/vehicle_data.db`.
  - You can reset it by deleting this file and rerunning the pipeline.

📞 Contact and Support

For any issues, feel free to open an issue on GitHub or contact:

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Enjoy monitoring your vehicles with AI! 🚗🧠
