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Phase 5: Project Demonstration & Documentation

Title: AI-Powered Traffic Flow Optimization System

Abstract:

The AI-Powered Traffic Flow Optimization System aims to revolutionize urban mobility by leveraging artificial intelligence, real-time data from IoT-enabled infrastructure, and machine learning algorithms. In its final phase, the system integrates advanced traffic prediction models, real-time data collection from smart sensors and surveillance devices, and secure data management. This document provides a comprehensive report of the project's completion, covering the live system demonstration, technical documentation, performance metrics, source code, and testing results. The project is designed for large-scale deployment with robust data handling and traffic control capabilities. Diagrams, source code snapshots, and interface screens will be included to demonstrate the system's structure and functionality.

1. Project Demonstration

Overview:

The Traffic Flow Optimization System will be demonstrated to stakeholders, showcasing its real-time capabilities, integration with smart infrastructure, and intelligent congestion management.

Demonstration Details:

- **System Walkthrough:** Live demonstration from traffic data collection to congestion heatmap generation and signal optimization.
- **AI Prediction:** Showcasing the AI model's accuracy in predicting traffic bottlenecks and adjusting signal timing dynamically.
- **IoT Integration:** Real-time traffic feeds from smart cameras, vehicle counters, and environmental sensors.
- **Performance Metrics:** Highlights include system response under heavy traffic simulations and prediction accuracy rates.
- **Security & Privacy:** Demonstration of how sensitive vehicle and infrastructure data is encrypted and securely managed.

Outcome:

The demonstration will prove the system's ability to respond to real-world traffic scenarios, optimize routes, and manage traffic load securely and effectively.

2. Project Documentation

Overview:

Complete documentation of the AI-Powered Traffic System is provided, including architecture diagrams, code explanations, and operational guidelines.

Documentation Sections:

- **System Architecture:** Visual representation of AI model workflows, IoT integration points, and data pipelines.
- **Code Documentation:** Detailed explanations for algorithms handling traffic predictions, realtime data streams, and traffic signal adjustments.
- **User Guide:** Instructions for traffic management personnel to interact with the system dashboard and interpret data.
- **Administrator Guide:** Information on system maintenance, data handling procedures, and security protocols.
- **Testing Reports:** Reports on model performance, system load testing, latency under scale, and security evaluations.

Outcome:

This documentation enables future developers and urban planners to scale, maintain, or improve the system.

3.Feedback and Final Adjustments

Overview:

Feedback will be collected from urban planning experts, test users, and city traffic authorities.

Steps:

- **Feedback Collection:** Surveys and observations during live tests to capture user experience and technical issues.
- **Refinement:** Adjustments made to prediction algorithms, dashboard usability, or hardware compatibility based on feedback.
- **Final Testing:** Post-adjustment testing to verify performance, security, and scalability.

Outcome:

The final version will be optimized for real-world deployment across city intersections and smart transportation hubs.

4.Final Project Report Submission

Overview:

The final report summarizes the entire project lifecycle, key innovations, technical challenges, and future potential.

Report Sections:

- **Executive Summary:** Summary of project objectives, system capabilities, and real-world impact.
- **Phase Breakdown:** Details on AI model design, real-time system integration, and performance evaluation across all phases.
- **Challenges & Solutions:** Documented issues like data latency, device compatibility, and traffic model inaccuracies—with implemented fixes.
- **Outcomes:** Summary of current capabilities including traffic congestion reduction, route optimization, and multi-intersection coordination.

Outcome:

A fully documented traffic optimization project, ready for scale and presented for academic or municipal review.

5. Project Handover and Future Works Overview:

Overview:

Project handover will include final system files, future development ideas, and operational guidelines.

Handover Details:

- **Next Steps:** Suggestions for integrating autonomous vehicle data, expanding to multi-city deployments, and using satellite traffic data.

Outcome:

The project is formally completed with all technical assets and future directions handed over to stakeholders or municipal authorities. **source code and working final project.**

```
main.py  Run  Share  Output
```

```
1 import pandas as pd
2
3 # Step 1: Sample traffic data for Phase 5 intersections
4 data = {
5     'intersection': ['P5-A', 'P5-A', 'P5-A', 'P5-B', 'P5-B', 'P5-B',
6                     'P5-C', 'P5-C', 'P5-C'],
7     'phase': ['Phase 5'] * 9,
8     'time_slot': ['Morning', 'Afternoon', 'Evening'] * 3,
9     'vehicle_count': [130, 95, 160, 110, 90, 105, 55, 65, 70]
10 }
11
12 # Step 2: Create DataFrame
13 df = pd.DataFrame(data)
14 print(" : Traffic Data for Phase 5:")
15 print(df)
16
17 # Step 3: Filter only Phase 5 (in case the dataset includes other
18 # phases)
19 phases_df = df[df['phase'] == 'Phase 5']
20
21 # Step 4: Calculate average traffic per intersection
22 avg_traffic = phases_df.groupby('intersection')['vehicle_count']
23 .mean().reset_index()
24 avg_traffic.rename(columns={'vehicle_count': 'avg_vehicle_count'},
25                    inplace=True)
```

```
 : Traffic Data for Phase 5:
intersection phase time_slot vehicle_count
0      P5-A Phase 5 Morning           130
1      P5-A Phase 5 Afternoon          95
2      P5-A Phase 5 Evening           160
3      P5-B Phase 5 Morning           110
4      P5-B Phase 5 Afternoon           90
5      P5-B Phase 5 Evening           105
6      P5-C Phase 5 Morning            55
7      P5-C Phase 5 Afternoon           65
8      P5-C Phase 5 Evening            70

Average Traffic at Phase 5 Intersections:
intersection avg_vehicle_count
0      P5-A           128.333333
1      P5-B           101.666667
2      P5-C            63.333333

Signal Timing Recommendations for Phase 5:
intersection avg_vehicle_count signal_adjustment
0      P5-A           128.333333 Extend Green Time
1      P5-B           101.666667 No Change
2      P5-C            63.333333 Reduce Green Time

=== Code Execution Successful ===
```