**Smartfleet App Comprehensive Guide**

User Interface Components

1. Title and Overview

Widget: st.title("SmartFleet Trip Optimizer - All Factors Aware")

Description: The title serves as the entry point, clearly identifying the application’s purpose—optimizing trip planning while considering multiple risk factors. The accompanying st.write provides a brief overview, setting the stage for the interactive tools below. This establishes a professional framework for fleet managers to engage with the system.

2. Control Sliders

Widgets:

st.slider("Crime Risk Threshold", 0.0, 1.0, 0.5)

st.slider("High Temp Threshold (F)", 70.0, 100.0, 85.0)

st.slider("Hour of Day", 0, 23, 18)

st.slider("Surge Multiplier", 1.0, 8.0, 1.0)

Description: These sliders allow users to adjust key parameters dynamically:

Crime Risk Threshold: A value between 0.0 and 1.0 (default 0.5) sets the threshold for avoiding high-crime zones, influencing route optimization.

High Temp Threshold (F): Ranges from 70°F to 100°F (default 85°F), adjusting weather-related risk avoidance based on temperature and precipitation.

Hour of Day: Selects a specific hour (0-23, default 18) to tailor risk and surge data to a time of day, enhancing temporal relevance.

Surge Multiplier: Adjusts from 1.0 to 8.0 (default 1.0), simulating demand-based pricing impacts on route costs. These controls empower users to customize risk profiles and operational strategies in real time.

3. Sensor Replacement Timers

Widgets:

st.subheader("Sensor Replacement Timers")

st.write for sensor life display

st.slider("Sensors Adj. Days Remaining", -100, 100, 0, key="sensor\_days")

Description: This section monitors the health of critical fleet sensors:

ADAS Obstacle Sensor and Terra Gyro Sensor: Display remaining days (e.g., 65 and 50 days by default), calculated from predefined lifespans (365 and 400 days) minus usage (300 and 350 days).

Adjustment Slider: Allows manual adjustment of remaining days (±100), updating the display dynamically to reflect maintenance schedules or recalibrations. This feature supports proactive fleet maintenance planning.

4. Simplified Route Plot

Widget: st.pyplot(fig)

Graph Description: This Matplotlib plot visualizes a simulated route across 77 zones using random coordinates. The line graph with markers (o-) represents a 5-step route, optimized to avoid high-risk areas based on the total\_risk score. The title includes the selected hour, surge multiplier, and risks avoided (out of 5), with a legend clarifying the risk-avoidance strategy. This graph provides a clear visual of route optimization effectiveness, aiding in strategic planning.

5. Chicago Map with Route, Crime Heatmap, and Alerts

Widget: st\_folium(m)

Graph Description: A Folium map centered on Chicago (41.8781, -87.6298) with a zoom level of 11 displays:

Crime Heatmap: Uses folium.plugins.HeatMap to highlight crime hotspots based on crime\_df latitude and longitude data, with a 15-pixel radius for density.

Route PolyLine: A blue line traces a 5-point route, reflecting the same optimization logic as the plot, with a popup label.

Alerts: st.warning messages flag high sentiment risks (negative event scores) and traffic risks (speeds < 20 mph), providing actionable insights. The aggregate savings and risk avoidance metrics (st.write) quantify financial and safety outcomes, making this a powerful geospatial tool for fleet oversight.

6. Fleet Management Dashboard

Section: st.subheader("Fleet Management Dashboard")

Description: This dashboard organizes key performance indicators into three columns, offering a holistic view of fleet operations.

Operational Overview

Widgets: st.metric for four metrics

Description:

Total Vehicles Active: Scales len(taxi\_df) \* 1000 to represent a million-car fleet.

Total Miles Driven Today: Calculates int(reward \* 1000) with a 1M-mile delta for context.

Uptime Percentage: Fixed at 99.8% to reflect high reliability.

Average Speed Across Fleet: Averages traffic\_df['SPEED'] for real-time velocity insights. This section supports operational monitoring and capacity planning.

Route Optimization Metrics

Widgets: st.metric and st.pyplot(fig1)

Description:

Routes Optimized Today: Fixed at 50, indicating daily optimization volume.

Average Risk Reduction: Computes (1 - total\_risk.mean()) \* 100 as a percentage of risk mitigated.

Total Money Saved: Estimates int(reward \* 20000 + 1000000) based on route efficiency.

Pie Chart: Displays risk\_avoided vs. 5 - risk\_avoided (clamped to non-negative) with green (Dodged) and red (Encountered) slices, showing risk avoidance effectiveness. This aids in evaluating optimization ROI.

Risk and Safety Insights

Widgets: st.metric for five metrics

Description:

Crime Risk Index: Averages crime\_risk hourly probabilities (fixed KeyError) as a percentage.

Weather Risk Index: Averages weather\_risk\_hourly as a percentage of adverse conditions.

Traffic Congestion Index: Percentage of speeds below 20 mph from traffic\_df.

Sentiment Risk Score: Mean of data['sentiment\_risk'] as a percentage of negative events.

Sensor Failure Risk: Sum of adas\_risk and terra\_risk means, indicating sensor health. This section enhances safety decision-making.

7. Sensor Health Monitoring

Widgets: st.metric and st.pyplot(fig2)

Description:

ADAS Sensor Remaining Life and Terra Gyro Sensor Remaining Life: Mirror the timers section, showing days remaining.

Wear Trend Graph: Plots a 10-window rolling mean of terra\_d2\_df['label'] against time, highlighting sensor wear patterns. This supports predictive maintenance scheduling.

8. Financial and Efficiency Metrics

Widgets: st.metric and st.pyplot(fig3)

Description:

Fuel Cost Savings: Estimates int(reward \* 5000) based on route efficiency.

Maintenance Cost Forecast: Calculates int(sensor\_risk \* 10000) tied to sensor health.

Surge Impact Graph: Plots base\_reward against taxi\_df['surge'], illustrating cost impacts of surge pricing. This section drives financial optimization.

9. Performance Metrics

Widgets: st.metric for three metrics

Description:

Average Latency per Route: Simulated between 50-200 ms for performance insight.

Error Rate: Simulated 0-5% for reliability tracking.

Throughput: Simulated 10-50 routes/min for capacity analysis. These metrics support operational tuning.

10. Alert and Incident Tracking

Widgets: st.metric, st.table, and st.line\_chart

Description:

Active Alerts Count: Sums risks from sentiment, traffic, and sensors.

Traffic Risk Table: Top 5 high-risk traffic incidents with TIME, REGION, and traffic\_risk.

Downtime Chart: Simulated 3-hour trend of downtime incidents. This enhances incident response.

11. Predictive Analytics

Widgets: st.metric for three metrics

Description:

Next Hour Risk Forecast: Increases total\_risk.mean() by 10% for predictive insight.

Sensor Failure Probability: sensor\_risk \* 100 as a percentage.

Traffic Jam Prediction: Percentage of speeds below 15 mph. This supports proactive planning.

12. Resource Usage

Widgets: st.metric for three metrics

Description:

CPU Load: Simulated 20-80% for resource monitoring.

Memory Usage: Simulated 30-90% for memory tracking.

Data Processing Rate: Simulated 100-500 rows/s for throughput. These metrics aid system health management.

13. Custom Gauges and Controls

Widgets: st.slider and st.metric

Description:

Risk Tolerance Slider: Adjusts crime\_threshold (0.0-1.0) for risk customization.

Surge Adjustment Gauge: Adjusts surge (1.0-8.0) for demand tuning.

Savings Target Meter: Displays int(reward \* 20000 + 1000000) with a $1M target. This section enables real-time operational control.

Conclusion

The SmartFleet Trip Optimizer - All Factors Aware is a robust tool for fleet management, integrating diverse data sources into a user-friendly interface. Each widget and graph contributes to a comprehensive decision-making framework, making it an invaluable asset for logistics professionals. This application demonstrates proficiency in data science, web development, and cloud deployment, positioning it as a strong portfolio piece for job opportunities in the transportation and technology sectors.