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Topic of Research: Optimal Parking Space Allocation in an Urban Area

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YOLOv4 Object Detection; Optimal Parking Allocation

Findings

The research investigated the effectiveness of the Optimal Parking Space Allocation Management (OPSAM) system in addressing urban parking inefficiencies, with a focus on Delhi's congested districts. The key findings are summarized as follows:

1. District-Specific Parking Behavior:

Observational and statistical analyses revealed critical patterns in parking demand, turnover rates, and user preferences. Areas like Chandni Chowk experienced extreme peak-hour congestion with search times exceeding 25 minutes, whereas peripheral districts such as Shahdara were underutilized. OPSAM reduced search times by approximately 40% through real-time updates and dynamic allocation.

2. Field Testing Outcomes:

Across Chandni Chowk, Connaught Place, and OKHLA, OPSAM reduced cruising times by an average of 25% and improved regulatory compliance by 15%. User satisfaction consistently exceeded 85%, highlighting intuitive interfaces, accurate navigation, and efficient reservation features. Feedback suggested improvements, including multilingual support and advanced industrial customization.

3. Predictive Analytics and Forecasting:

OPSAM effectively forecasted peak demand periods and pre-allocated premium spaces during high-traffic events, improving utilization rates by up to 20% in Connaught Place and mitigating congestion during festivals and business hours.

4. Simulation Results:

OPSAM demonstrated measurable impacts on urban mobility, including a 15% improvement in parking utilization, a 12% reduction in CO₂ emissions, and decreased idle cruising. Chandni Chowk recorded a 30% enhancement in parking efficiency, reflecting the system's alignment with sustainable urban mobility objectives.

5. **Comparative Performance:**

Compared to traditional, sensor-based, and RFID-enabled systems, OPSAM outperformed in detection accuracy (92%), reduced average search times to approximately 9 minutes (compared to 20 minutes in non-guided systems), and showed strong scalability across diverse urban areas.

6. **User Compliance and Regulation:**

The system improved adherence to parking regulations from 65% to 80%, reducing illegal parking and unauthorized use of reserved spaces, easing enforcement burdens, and enhancing traffic discipline.

7. **Environmental and Economic Benefits:**

OPSAM's reduction in cruising times led to a 12% decrease in CO₂ emissions, benefiting urban air quality. Economically, drivers saved on fuel and vehicle wear, while operators experienced increased revenue due to improved space utilization.

8. **Adaptability and Scalability:**

OPSAM demonstrated flexibility across different urban contexts:

- **Chandni Chowk:** High congestion management with maximum reductions in search times and emissions.
- **Connaught Place:** Balanced dynamic demand for premium and regular parking spaces.
- **OKHLA:** Tailored solutions for industrial parking and long-term vehicle needs.