HackOrbit 2025

Byte Bandits

THEME & PROBLEM STATEMENT

UrbanFlux: A YOLOv3-Based Intelligent Traffic Regulation Platform

Urban areas face severe traffic congestion due to fixed-time traffic signals that do not adapt to real-time vehicle flow, leading to increased delays, fuel consumption, and pollution. There is a need for an intelligent system that dynamically regulates traffic based on live vehicle detection.

PROPOSED SOLUTION

- Develop UrbanFlux, an intelligent traffic regulation platform.
- Utilize YOLOv3, a deep learning model, for real-time vehicle detection.
- Capture video feeds from multiple traffic lanes using cameras.
- Count vehicles dynamically in each lane using computer vision.
- Adjust traffic signal durations based on live vehicle density (e.g., green signal: 60 seconds, yellow signal: 5 seconds, Red signal: 10 seconds).
- Prioritize high-density lanes and critical zones (e.g., hospitals, schools).
- Reduce congestion, wait times, fuel consumption, and emissions.
- Ensure continuous real-time processing using OpenCV.
- Provide a scalable, adaptive, and cost-effective traffic management solution for smart cities.

FLOWCHART / DIAGRAM

Start / System Init

Capture Video from Lanes

Use YOLOv3 to Detect Vehicles

Count Vehicles in Each Lane

Adjust Green Signal Based on Vehicle count

Update Traffic Signals Accordingly

Store Data for Analysis and future optimization

Repeat Countinuosly and END

working of dynamic signalling(demo model)

FLOWCHART / DIAGRAM

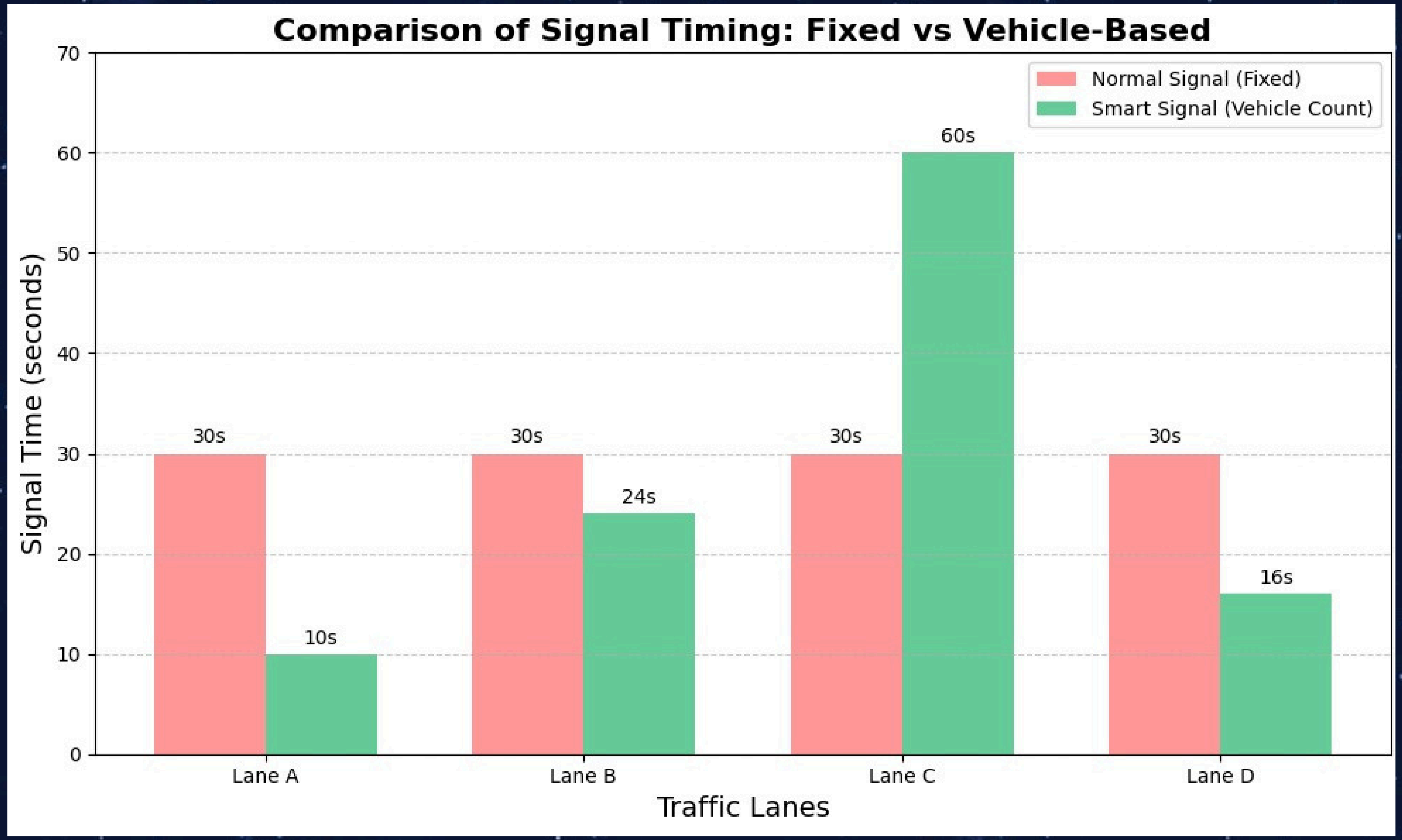
FLOWCHART

It outlines the working of a real-time adaptive traffic signal system using YOLOv3. The system begins with initialization and starts capturing live video feeds from multiple traffic lanes. YOLOv3 is then used to detect and count vehicles in each lane. Based on the real-time vehicle count and traffic conditions, the system dynamically calculates the appropriate green light duration, ensuring efficient signal allocation. The traffic lights are updated accordingly to optimize flow. All traffic data is stored for future analysis and system improvement. This process runs continuously, adapting to changing traffic patterns in real time, thereby reducing congestion, improving fuel efficiency, and supporting smart traffic management.

DIAGRAM

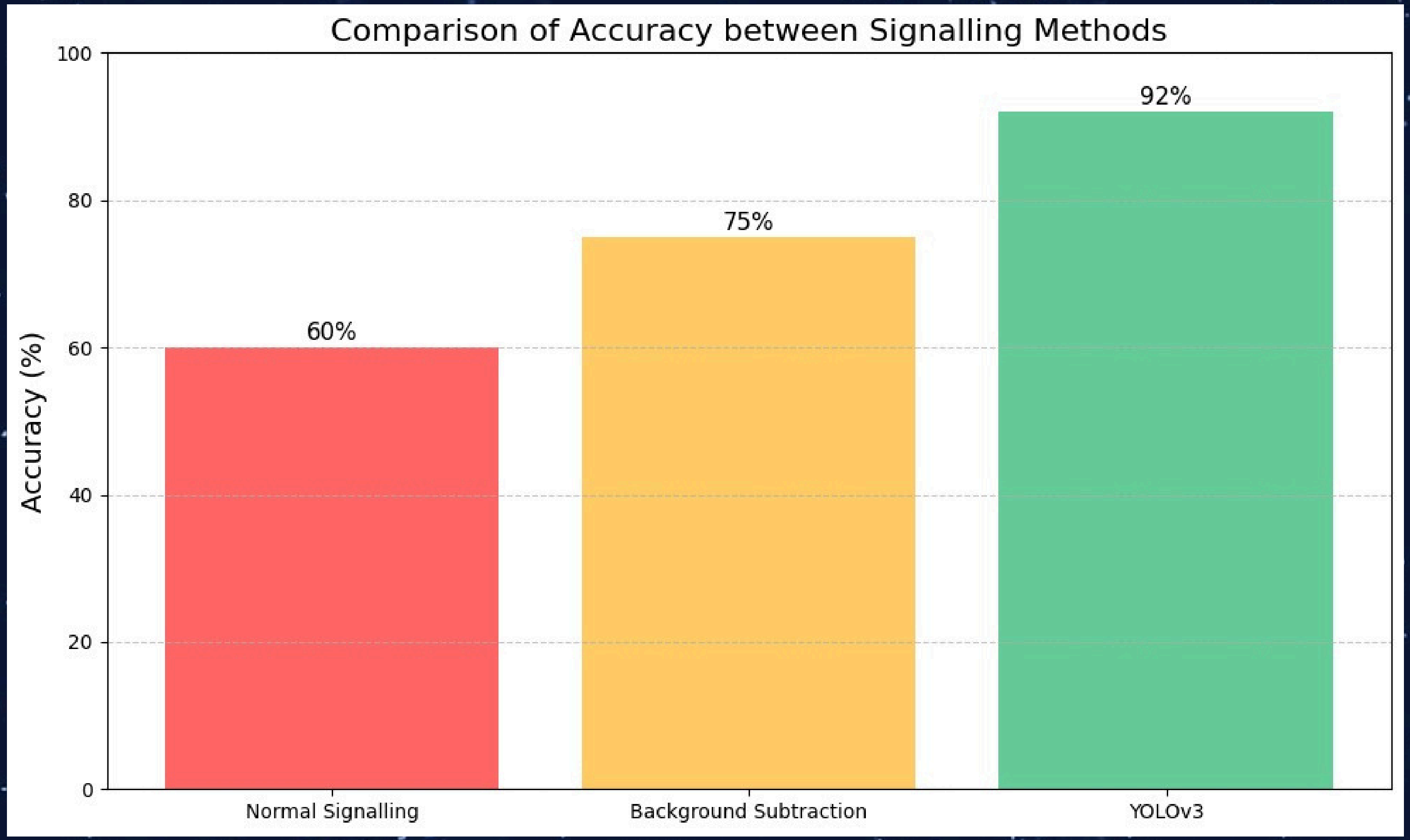
we observe four traffic lanes, each regulated with predefined minimum and maximum green signal durations. This dynamic timing mechanism adapts based on real-time vehicle count, significantly reducing congestion. When vehicle detection is absent or mismanaged, valuable signal time is wasted, resulting in unnecessary fuel consumption and increased pollution. By leveraging intelligent traffic control through dynamic signalling, we can address these challenges efficiently. While some countries have attempted to solve congestion by widening roads, such infrastructure projects are often expensive and not always feasible. In contrast, smart traffic management systems offer a more cost-effective and scalable solution by optimizing existing infrastructure through technology.

Normal Signaling vs smart signalling (YOLOv3)



This graph shows a comparison between two types of traffic signal timings: normal fixed timing and dynamic timing based on vehicle count. In the normal method, every lane gets the same green signal time of 30 seconds, no matter how many vehicles are there. This can cause delays or waste time when there are fewer vehicles. In the dynamic method, the green signal time changes based on the number of vehicles in each lane. For example, if there are more vehicles, the green time increases (up to a maximum of 60 seconds), and if there are fewer, it decreases (minimum 10 seconds). As shown in the graph, Lane C with the most vehicles gets more time, while Lane A with fewer vehicles gets less. This helps to manage traffic better by giving more time to busy lanes and less to empty ones, reducing waiting time and improving traffic flow.

Normal Signaling vs Background subtractor vs YOLOv3



YOLOv3's high accuracy is attributed to its ability to learn robust features from large datasets using deep learning techniques. In contrast, Background Subtractor's moderate accuracy is due to its reliance on background modeling and subtraction techniques, which can be effective but may struggle with complex scenes. Meanwhile, the lower accuracy of Traditional Methods is due to their reliance on hand-crafted features and simple classifiers, which can be limited in their ability to handle complex and varied data.

YOLOv3 (90-95%) > Background Subtractor (75-90%) > Traditional Methods (60-75%)

FEATURES AND NOVELTY

FEATURES

- Utilizes the YOLOv3 object detection algorithm for fast and accurate identification of vehicles at intersections.
- Dynamic signal light timing based on live vehicle count
- Continuous monitoring using OpenCV
- Traffic data logging for analysis and future optimization
- Assigns higher priority to lanes with higher vehicle density, reducing waiting time and idle fuel consumption.

NOVELTY

- **YOLOv3-based real-time traffic control:** Integrates deep learning for dynamic signal decision-making.
- **Vision-first approach:** No need for external sensors—uses only camera input and computer vision.
- **Lane-wise adaptive logic:** Dynamically adjusts green light durations based on actual congestion in each lane.
- **Eliminates fixed-timer inefficiency:** Replaces outdated systems with responsive, data-driven control.

DRAWBACK AND SHOWSTOPPERS

DRAWBACKS

- **High Computational Requirements:** Real-time vehicle detection using YOLOv3 requires powerful GPUs or edge devices, which may not be cost-effective for all intersections.
- **Dependency on Video Quality:** Low light, rain, fog, or low-resolution cameras can reduce the accuracy of vehicle detection.
- **Data Privacy Concerns:** Continuous video surveillance might raise concerns regarding data storage, privacy, and security.

SHOWSTOPPERS (CRITICAL FAILURES THAT HALT SYSTEM FUNCTIONALITY):

- **Camera Failure or Obstruction:** If cameras malfunction or are obstructed (e.g., by dust, vandalism, or weather), the system cannot detect vehicles and may default to inefficient signal patterns.
- **Real-Time Processing Failure:** If the system cannot process data fast enough, it fails to adapt the signal in time, defeating the purpose of real-time control.
- **Power Outages:** No fallback mechanism during power loss can make the entire intersection dysfunctional unless battery/UPS support is provided.

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Thank you