Density Based Traffic Light Control System using ESP-32

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Abstract: *Traffic congestion is a significant problem in urban areas, leading to delays, fuel wastage, and increased pollution. Traditional fixed-time traffic light systems fail to adapt to varying traffic conditions, causing inefficiencies. A Density-Based Traffic Light Controller (DBTLC) offers a smart solution by dynamically adjusting traffic signal timings based on real-time traffic density. This system utilizes sensors, such as infrared (IR) sensors, cameras, or inductive loops, to measure the number of vehicles at an intersection.*

The collected data is processed using microcontrollers or embedded systems, which then regulate traffic lights accordingly. Roads with higher vehicle density receive longer green-light durations, while roads with lower traffic density experience shorter green phases. By implementing a density-based approach, this system optimizes traffic flow, reduces waiting time, minimizes fuel consumption, and enhances overall road efficiency. It can also be integrated with smart city technologies, such as IoT and AI-based predictive analytics, for further improvements. This paper discusses the design, working principles, advantages, and challenges of a Density-Based Traffic Light Controller, highlighting its potential to revolutionize urban traffic management. The project is aimed at designing a density based dynamic traffic signal system where the timing of signal will change automatically on sensing the traffic density at any junction. Traffic congestion is a severe problem in most cities across the world and therefore it is time to shift more manual mode or fixed timer mode to an automated system with decision making capabilities.

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