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SMART CITY

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SUMMARY
Due to a lack of infrastructure, an increasing number of cars and people, persistent delays, fuel waste, and rising pollution, the modern cities are experiencing traffic congestion. Through the real-time analysis of camera feeds and AI-based image processing, the Smart Traffic Management System addresses the key traffic issues by monitoring and regulating traffic lights. The remaining empty lanes are red, while the green traffic lights are longer for congested lanes, which helps to reduce delays and improve traffic flow. The Smart Street Light System, which is based on the principles of road safety and energy conservation, replaces the old, energy-guzzling streetlights with overextended systems run by counters and controls. Using an Arduino microcontroller platform and passive infrared and ultrasonic sensors, light control systems were created to provide straightforward and real-time responsive sensor-based streetlight systems.

Keywords: public transit automation, QR code ticketing, intelligent street lighting, emergency vehicle detection, AI-based traffic control, image processing, computer vision, and traffic congestion management

INTRODUCTION
The issues facing cities like Bangalore and Mumbai are brought about by their concurrent development. Traffic and transportation is one of the issues. Manual control has several drawbacks, such as the inability of the set timer signals to react to urgent or emergency events. Real-time CCTV cameras, which can process live video streams, can be used in this way to monitor traffic intersections. The quantity of traffic can be monitored by these CCTVs, which may then send signals as necessary. Additionally, it can scan for ambulances, send signals to them, and quickly clear the route for them. These sophisticated capabilities are built into systems that connect with Raspberry pi, Arduino mega 2560, OpenCV, and Python. The access and control of these systems is managed in a very centralized way via VNC. By reducing congestion along vital routes, these systems enhance the overall traffic response to crises.
Street lights consume a lot of electricity when they stay on all night, and that energy is being wasted. This issue can be resolved by the Smart Street Light System, which can conserve a lot of energy by turning the light on or off depending on the circumstances. Inductive street lights with motion sensors are also able to turn on or off in the same way. In addition to reducing energy use for maintaining these lights on, the Smart light System also reduces the expense of managing light systems.
By incorporating several digital technologies like payment systems, data management systems, and QR code technology, SBTIS has made the task of ticket systems easier. With this, ticketing can be automated without any problems.
The sole element that will make future integration with different metro systems and other transportation systems possible is this efficiency. For the last ten years, the development of intelligent traffic management systems has remained in an adaptive, AI-driven paradigm. This

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is partly because the prior static methods were no longer adequate. One of the most important breakthroughs in public transportation is, and will continue to be, the automated determination and issuing of ticket relevancy through the internet.

LITERATURE SURVEY

The research paper titled "Smart Control of Traffic Light System Using Image Processing" proposes a way to use video and image processing to make traffic lights smarter and more responsive.

Cameras placed at traffic junctions send a live video stream to the system. First, this video is processed locally to identify important details, such as the amount of traffic and the number of cars waiting at a light. The information is processed and then sent to a central server, where a C++ algorithm analyzes it and decides how the traffic signals should be managed.

Using fuzzy logic to enhance traffic signal control, 2019 [3] suggests an Arduino-UNO based system that seeks to alleviate traffic congestion and wait times. The camera captures images for this system, which are then processed in MATLAB, where the image is transformed into a threshold image by eliminating saturation and colors, and where traffic density is measured.

Video processing is used to calculate traffic density and intelligently switch traffic lights in 2020 [6] using a support vector machine algorithm in conjunction with OpenCV image processing methodologies.

For these systems, different sensing and control techniques have been investigated. Passive Infrared (PIR) and Infrared (IR) sensors are still widely used because they are inexpensive and use little energy. However, their usefulness has been restricted by their limited range of motion detection and temperature sensitivity (Smith & Patel, 2018). Sonar/Ultrasonic based sensors, such those utilized in Ubi Bench, detect reflections off objects and are less sensitive to lighting but more susceptible to acoustic noise (Garcia et al. , 2020). LDRs or photocells are frequently used to detect daylight, and they are often combined with a motion sensor to prevent false daytime operation (Chen & Rao, 2017).

However, more sophisticated solutions, such radar or microwave-based sensors, provide greater range and superior weather resistance. Some municipal trials (City-Y Pilot, 2022) have demonstrated their effectiveness in high-speed vehicular traffic. Camera-based systems driven by computer vision are able to recognize objects and utilize adaptive illumination techniques with more expensive and privacy-sensitive devices (Zhang et al. , 2023). The use of sensor networks in IoT devices enhances scalability via technologies such as LoRa, Zigbee, or Wi-Fi, for remote monitoring or centralized control (Smart-City Project A, 2020).

Today's ticketing systems are built upon the cornerstone of security. The Open Web Application Security Project (OWASP) [11] has suggested a number of best practices for secure web applications, including enforcing SSL with HTTPS, using a token-based authentication model, hashing user passwords, and encrypting sensitive data. These are essential for preventing the breach of users' privacy

PROPOSED SYSTEM ARCHITECTURE

Using AI, IoT, and digital technologies, the Smart City System integrates several technological solutions for traffic management, street lighting, and public transportation ticketing into a single, seamless framework that enhances the efficiency, safety, and sustainability of urban mobility.

The system uses a motion sensor system based on an Arduino to implement the use of fundamental time-controlled lighting and sensor limitation for street lighting. By automatically

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turning on the lights when the motion sensor identifies movement within a specified radius, the system reduces the amount of electricity that is wasted.

OBJECTIVES

The Smart City project has a broad scope. Its main goal is to
The focus and goals are as follows:
1. Intelligent Traffic Management
2. Intelligent Street Lighting
3. Intelligent Ticketing System

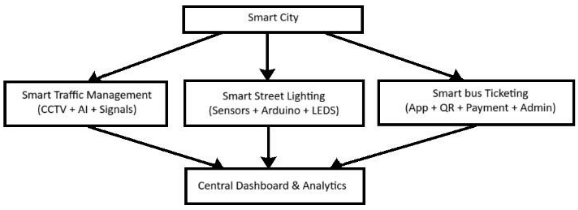

Fig 1: A diagram of the smart city

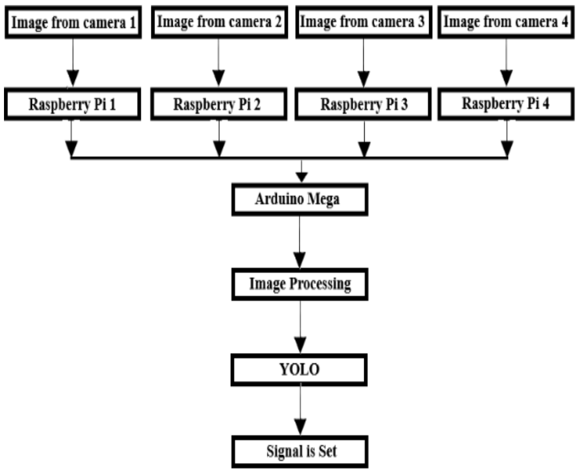

Fig 2: Diagram of the Intelligent Traffic Management

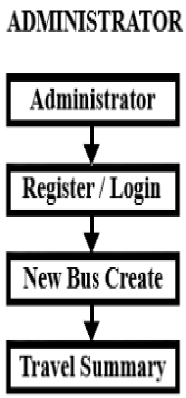

Fig 3: Smart Bus Ticketing Management

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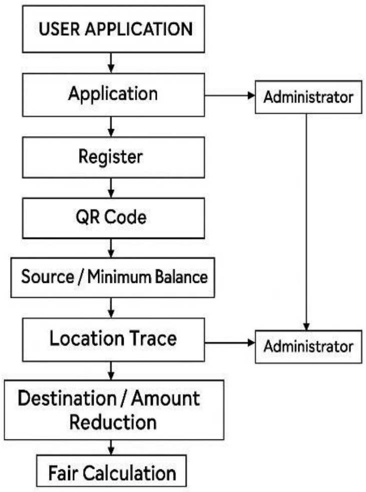

Fig 4: the Smart Bus Ticketing system

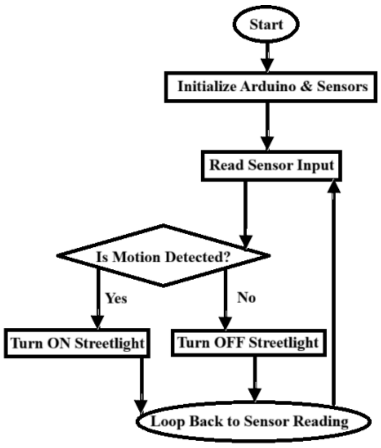

Fig 5: Diagram of a Smart Street Light's

SYSTEM REQUIREMENTS

There are system requirements there that come from both hardware and software.

Hardware Requirements

1. INTELi3/i5
2. HARD DRIVE
3. RAM
4. CAMERA
5. Arduino Mega 2560
6. LCD Screen
7. Jump Wire
8. Raspberry Pi
9. Adapter for HDMI to D-type
10. Warning light
11. Electricity
12. IR Sensors
13. light emitting diode

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Software Requirement
1. System of Operation
2. Python
3. OpenCV
4. The VNC Viewer
5. Mobile
6. Cloud server
7. Location
8. Camera
9. Application
10. Android Studio

RESULTS AND OUTCOME

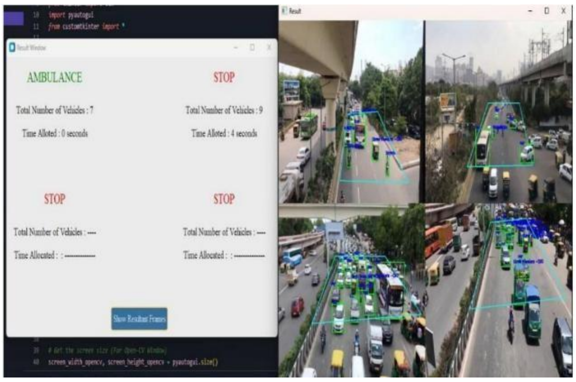

Fig 9: Software-based Smart Traffic Management Output

As seen in this output, the computer-vision traffic controller uses a camera to continually monitor all four lanes, count the number of cars in each lane, and provide the green signal to the lane with the greatest traffic density, while maintaining the other lanes on red to minimize wait times. Additionally, it has an emergency-vehicle priority mode that automatically halts all other lanes when an ambulance is discovered (as illustrated in lane 2). With the primary UI, the user may run tests using both new and old frames and initiate an Emergency Vehicle Demonstration to prioritize ambulances. The number of cars per lane and the allotted green signal time for each camera frame are shown in the result window. The lane area is determined using chosen ROI points, and when an ambulance is identified (as in lane 1), the system prioritizes priority clearance through the intersection by designating that lane as AMBULANCE and changing other lanes to STOP.

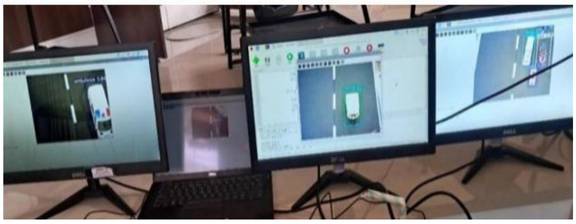

Fig 10: Output of the Intelligent Traffic Management Prototype

The hardware + simulation prototype of the smart traffic junction is demonstrated by this output. Live camera feeds of the model junction are shown on several monitors, where

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vehicle/emergency detection is performed in real time and the controller determines which road gets green and which stays red. The physical model has a central camera unit, traffic lights, and four intersecting roads; when an ambulance is present on any approach, that road is given priority with green. Live vehicle counts per road and signal status are shown by hardware vehicle counters with LCDs. The LCD shows "EMERGENCY" and may specifically display "AMBULANCE DETECT IN ROAD 1", confirming the detection of an emergency vehicle.
that priority will be given to speed travel along Road 1. With a confidence score (example: 0. 69), the system can also identify other emergency vehicles, such as a fire engine, demonstrating its capacity for detecting numerous emergencies.

Fig 11: Intelligent Street Light Module

The intelligent street light automation model is depicted in this output at a four-road junction, where each road features sensor-based LED posts that turn on only when a vehicle is present and stay off otherwise to conserve electricity. The control software, which runs on the laptop, continuously monitors detection zones and automatically manages the lighting. The LEDs turn on to light the way for an ambulance, for example, when it enters the sensing area, and they turn off when the road is clear to conserve energy.

Fig 12: Intelligent Bus Ticketing System is depicted

The intelligent bus ticketing ecosystem is represented by this output. The web login screen for the administrator is the interface for managing buses, users, and ticket information on the system's admin side. The passenger side is a mobile app with a login page and a home/user page that offers essential features such as User Profile Details, View Balance, Scan QR, and Sign-out. The ticket QR code is read by the Scan QR screen, which then displays scanned data for verification; the user may then click Submit to complete the transaction. With choices to return or log out, the View Balance page displays the wallet balance (for example, 1000 Rs) that was used to purchase the tickets. Additionally, a separate QR/barcode scanning window shows how to scan a ticket QR code and immediately retrieve passenger/trip information for payment or verification.

CONCLUSION

Smart Traffic Management Systems, Smart Street Lighting, and Smart Bus Ticketing Systems are all examples of the reality of the technological world and how it is changing into the cities of
the future, which will be intelligent, environmentally friendly, and livable for its citizens.
The Smart Traffic Management System's choices are based on the neural network used to analyze
the density of the traffic using AI methodologies and YOLO based on the identification of ambulances, even in the absence of specific traffic congestion information. The system gaine control of traffic signal timing every time the ambulances were made available through it, but it also gave the other cars in the vicinity an uninterrupted signal.

The automation of ticketing is used by the Smart Bus Ticketing System. You may scan a QR code at the entrance to board each vehicle using this digitalized public transportation system. When distance is on a parcel ticket, all recesses are also computed as needed according to the distance traveled, apart from ticketing. The system modes may also be extended to include metro, ferries, and trams.

REFERENCE

[1] Patel, A. , and Shah, R. , 2019, Secure QR Code Based Ticketing for Public Transportation.
[2]"Smart Controlling for Traffic Light Time," by A. A. Zaid, Y. Suheil, and M. A. Yaman, 2021.
[3] "Traffic Light Control and Violation Detection Using Image Processing," Ranjith Soman, 2020.
[4] Smart Traffic Lights Switching and Traffic Density Calculation Using Video Processing, A. Sharma, A. Kanungo, and C. Singla, 2020.
[5] M. Priya and S. Karthikeyan, 2021, Raspberry Pi for IoT-based Intelligent Traffic Management.
[6] Transport for London (TfL), 2020, "Contactless Ticketing and Validation Systems".
[7] Ray P et al, 2021, “Passenger Analytics for Smart Public Transport Systems".

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