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TRAFFIC LIGHTCONTROL SYSTEM BASED ON DENSITY AND USING RASPBERRY PI

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Abstract:

Nowadays, there is an increase in vehicle traffic everywhere, particularly in cities. In the future, smart traffic management will become a critical problem as the number of road users continues to rise. Traffic congestion is starting to become a major problem. Due to the lengthy wait times at traffic signals, more time is spent by humans, which causes several issues for those who commute to work and for those who work for businesses. The current system does not regulate traffic in accordance with density and does not lessen the impact of traffic in urban areas. Traffic lights are created in advance and fixed for a certain amount of time before being changed to a different signal. The other side roads are delayed significantly as a result. There were instances when traffic signals malfunctioned. The suggested system measures the number of vehicles and reduces traffic correspondingly by using image processing and a Raspberry Pi. With the use of an RF transmitter and receiver, emergency vehicles such as ambulances and fire engines may be readily admitted into traffic. Vehicles that resemble ambulances transmit a signal to a receiver, which causes the green light on the road to shine. This improves the safety of the patients within the ambulance, and it also applies to fire trucks. When the red light is on, road crossings are avoided thanks to infrared sensors. A density-based traffic control system helps to monitor traffic updates. The Raspberry Pi and modules including a camera, infrared sensor, radio transmitter, receiver, and actuator are the hardware components utilised in the project. These modules are interfaced with the Raspberry Pi in order to regulate traffic and ensure correct output. The background removal approach in image processing is used to create software. Python is the programming language utilised to carry out the implementation. The VNC viewer programme is used to carry out the implementation using these hardware and software components. The module will operate in accordance with the programme, which has already been thrown into the application.

I. Introduction:

Around the globe, a persistent issue in many cities is traffic congestion. Delivery delays, missed trade opportunities, and reduced labour productivity are all consequences of congestion. Modern traffic lights need a lot of maintenance while they are in use and employ a manual operating mechanism for time allocation. Time is slipping away as a result, and traffic volume is rising. By reducing traffic and allowing cars depending on road density, the suggested approach reduces traffic. Through the use of picture processing and Raspberry pi operation, the project seeks to lessen traffic in places with high vehicle density.

In many contemporary cities around the globe, traffic congestion is a severe issue. The intricacy of traversing various locations throughout the city is increasing for commuters. People waste time, miss out on opportunities, and get upset as a result of the

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traffic issues. Due to worker productivity losses, missed trade opportunities, supply delays, and other factors, traffic congestion raises costs. Global traffic control systems are a serious problem. It is acceptable for emergency vehicles to violate regulations in order to get at their location on schedule. After the collision, the information is not immediately received by the emergency vehicles. It requires a different kind of traffic management mechanism than industrialised nations have. The detrimental effects of congestion may be lessened by competent traffic management. Due to their increased cost-effectiveness, wireless networks have been primarily used in road transportation in recent years. Traffic signals in the majority of modern systems are operated by predefined timing circuits, which are inefficient since they don't adjust to the amount of traffic at the crossing at any given time [1]. Modern automated traffic management systems often encounter this issue because cars must wait at a road crossing when there is little to no traffic travelling in the other direction. Sensor-based systems have been proposed as an enhancement over fixed time controlled ones for managing traffic congestion. With a sensor-based system, handling numerous detections might sometimes be challenging as well. These methods deal with intersections with many lanes, multiple vehicles, and several roads. It offers a productive time management system in which the timing of each traffic column's passing is determined in real time. The system's real-time functioning aligns with the decision-making of an on-duty traffic cop. It was considered how to employ wireless sensor networks to create a priority-based traffic light controller that would change all red lights in the emergency vehicle's route green as it approached, based on the priority given to it. By giving this system instructions to make judgements depending on the traffic density present in its surroundings, efficient traffic management is accomplished. The benefit is that these automated systems in [3] may be used to monitor traffic in places where it would not be possible to post personnel or where accidents are likely to occur, like as hilly regions or small tunnels. This is because they don't need human involvement. This essay is structured as follows: Section 2 covered the relevant works. The suggested system architecture and framework were briefly covered in Section 3. The analysis and discussion of the experimental data are covered in Section 4. The study is concluded in Section 5 with a suggestion for a follow-up project.

Growing populations therefore cause automobiles to be used more often, which raises traffic levels in various places [1]. The primary factor causing slower speeds, longer wait times, accidents, and annoyance is traffic congestion. Therefore, we suggest utilising a Raspberry Pi 3 to start a density-based traffic light in order to minimise traffic via signal regulation in order to assist resolve this problem. Traffic congestion has been cited as a key reason. It is important to regularly monitor the trend of traffic congestion to guarantee that infrastructure development is executed with efficacy. Furthermore, delays in travel times, lengthier wait periods, and the possibility of traffic infractions have all been linked to traffic congestion. Routine traffic light signals cannot detect changes in road density since they are timed to a certain interval. Technology advancements are making systems smarter and more sophisticated. Compared to a few years ago, managing and monitoring remotely is now

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possible and not a tough effort. Advanced systems are designed to transfer data at extremely high speeds thanks to better internet connection [2]. This communication served as the foundation for some incredible technology advancements that were introduced to the market. This research enables the use of the Raspberry Pi 3 with image processing capabilities as one of the potential answers to the issue of traffic congestion. First, we do a literature review. On the basis of this, we create an Internet of Things system that uses image processing to monitor and manage traffic signals depending on density. The system for tracking traffic density, automatic signalling, and human signalling is put into practice and simulated.

Figure:- 1 Traffic congestion.

II. LITERATURE SURVEY:

1. Intelligent Traffic Control System using Raspberry pi:

Because of the enormous rise in the number of vehicles on the road, traffic control systems pose major risks in almost every nation. The current traffic system must be integrated with an existing technology to minimise complexity and time. Emergency services are groups that respond to various crises in order to guarantee public safety. When the traffic signal is red, they are permitted to go past the intersection since the cars won't get at their destination in time. Emergency vehicles, such as fire engines and ambulances, must get at their destination as soon as possible. Using Raspberry Pi, an intelligent traffic management system has been created to solve the traffic issue. This technique facilitates ambulance clearance and the traffic system in a timely manner. This system uses RFID and infrared sensors installed on traffic signals to identify vehicles and save vehicle data for later use. A sensor gathers information based on the count of cars and stores the data. Any emergency vehicle that detects a traffic jam will automatically detect the signal and change it from green to red. It will also identify if there are many cars waiting on the signal and will adjust the light appropriately. when the light has been altered without the traffic police's knowledge. It is possible to verify the specifics of traffic fluctuations across the internet by using Flask Web Application Technology. By developing an application with a local IP address, traffic cops will be able to use it to monitor changes in traffic patterns anywhere. It is both cost-effective and helpful in reducing labour.

2. DENSITY BASED TRAFFIC CONTROL USING IoT:

Traffic congestion results from an increase in vehicle volume on the road network brought on by the quick growth of road infrastructure. The cities of

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Coimbatore are in precisely the same predicament. One of the main issues Muscat and the surrounding cities around Coimbatore confront is traffic congestion. This is mostly brought on by the sudden and sharp increase in the number of cars in a little amount of time. The development of an IoT-based traffic management system is necessary to mitigate the effects of traffic congestion. The real traffic density on the route would serve as the foundation for the suggested solution. Techniques for processing images and videos in real time would be used to accomplish this. In order to determine the density, the photographs that were taken and saved on the server will be compared to the images that were taken in real time using a camera. The idea is to regulate traffic by measuring the amount of traffic on each of the four roadways' sides and giving the user access to a traffic signal management feature via a software programme.

Numerous research projects attempt to address transportation and traffic management issues by using a variety of strategies, including digital image processing, wireless sensor networks, artificial intelligence, and sensors. In [3], a number of infrared sensors is placed along the length of the road in order to count the number of cars in each lane. The data is then transferred to the cloud via a Bluetooth connection, where traffic density information is used to feed KNN-based clustering algorithms, which in turn determine the anticipated timing of traffic lights. In addition to adding to the system's complexity, using short-range communication technologies like Bluetooth necessitates that the access points be close to the sensor array in order to achieve data transfer. Additionally, using a clustering algorithm based on KNN increases the overhead in the cloud computing system, which could cause delays in decision-making and alter the timing of traffic lights, both of which would have a negative impact on traffic. Another idea for an Internet of Things-based traffic signalling system that makes use of ultrasonic sensors was developed in [4]. In this system, ultrasonic sensors are placed every 50 metres along the road to measure traffic density. The data is then communicated to Arduino, which controls the traffic signals accordingly. Density information is also transmitted via Wi-Fi to a Raspberry Pi 3, which analyses the data to determine which traffic is heavy and which is light. The data is also communicated to a cloud-based webpage that can be viewed by traffic police authorities for additional analysis. This method requires a large number of sensors spread out far, which is impractical and difficult to manage. It is also a waste of resources to use ultrasonic sensors—which are primarily used to determine distance—to detect things. An embedded system placed in an ambulance that comprises of an Arduino Uno, a GPS Arduino shield for monitoring the ambulance, and a GSM Arduino shield to update the ambulance position on a web database was suggested by [5] in an effort to lessen the danger of traffic congestion during crises, particularly involving ambulances. This proposal does not account for traffic density and the time required to reach the traffic signal, which could result in an early road evacuation in the case of low traffic density and, consequently, inaccuracy in the timing of the signals, which could increase the density in other directions or delay the evacuation in the case of high traffic density. The system tracks the path of the ambulance and controls the traffic lights to ensure that road junctions are free of congestion, making it easier for ambulances to pass smoothly and without

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delay. [6] uses image processing techniques and the "ThingSpeak" IoT platform to calculate traffic density. This system installs IP webcams on traffic intersections, records video, and broadcasts it to a server where video and image processing techniques, such as segmentation and features extraction algorithms, are used to obtain a quick overview of the traffic situation. The system also calculates the total number of vehicles and uses image processing from the camera to detect the presence of animals on the road. Utilising the MATLAB programming environment, the suggested system is developed. Thing Speak Channel would be used for the study of traffic monitoring.

III. METHODOLOGY:

The Raspberry Pi, Python image processing, Pi-Camera, IR sensor, motor, and RF transmitter and receiver are all used in the construction of this traffic controller. To transform the unprocessed photos into a more readable format, image processing is done. The primary part that controls everything is the Raspberry Pi, which functions as a controller. The pi camera records traffic, and it sends this data to a computer. The Raspberry Pi and PC are linked to carry out the hardware implementation, which uses a traffic control system to regulate the signal.The motor is turned on by an infrared sensor. When the red light is on, the motor with nails is positioned underneath the traffic light to regulate traffic. Using an RF transmitter and receiver, emergency vehicles such as ambulances and VIP cars are also permitted.

BLOCK DIAGRAM:

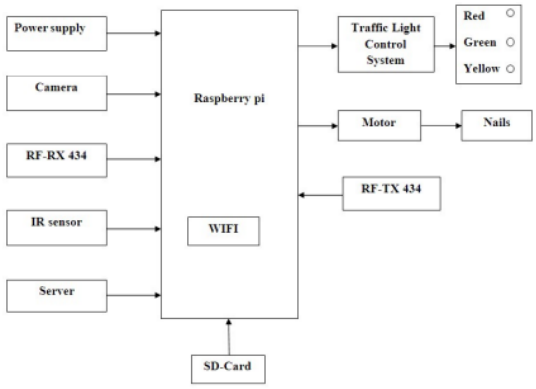

Fig. 3.1 depicts the functional block of the density-based traffic signal control system. In this instance, an IR sensor is used to identify vehicles, a camera is used to record traffic, and a motor is attached to the IR sensor to prevent cars from crossing the road while a red light is on. The Raspberry Pi is originally fitted with an SD card. The Raspberry Pi's WIFI module is also interfaced with, and it connects the hardware package and PC. The tool used to connect the Raspberry Pi to the computer is called VNC viewer. The system known as a PC is called a server. When an IR sensor detects a vehicle, a motor is attached to the nails to tilt the car.

CAMERA MODULE:

The original Raspberry Pi camera module and all Pi versions are compatible with the one with adjustable focus. The module's major component is the 5-megapixel OV5647 sensor. A cable is used to connect the camera board to the Raspberry Pi. There are only two connections to be made: the cable must be fastened to both the Raspberry Pi and the PCB of the camera. The camera won't operate if the cable is not inserted correctly. The Raspberry Pi's blue cable

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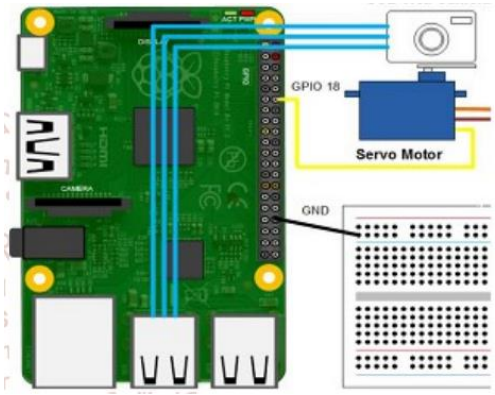
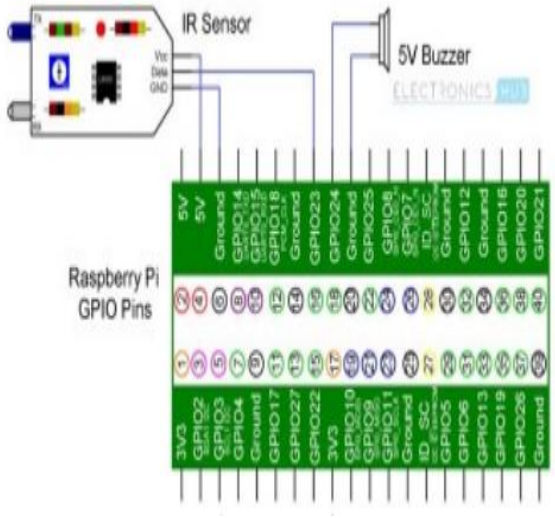
backing should face the Ethernet connection, while the camera PCB's should face away from the PCB.



IR SENSOR MODULE:

An infrared sensor has both a transmitter and a receiver. The IR rays that will impact the item are emitted by the transmitter.When the red light is on, the car that crosses the road is identified by an infrared sensor. The IR sensor, which is attached by nails, triggers the engine when the car attempts to cross the street. The motor tilts the nails, making it impossible for a car to cross the road while the red light is on. Using cables, the Raspberry Pi is interfaced with the IR sensor. Triple-pin IR sensors are labelled VCC, GROUND, and OUT. The motor that rotates it and the Raspberry Pi's GPIO2 pin are both linked to VCC. GROUND is wired to both the traffic signals and IC. The Raspberry Pi's GPIO26 is linked to the OUT pin.



When a car crosses the street with the red light on, these pins are utilised to spin the motor. The IR sensor is used to detect automobiles since it has a transmitter and receiver. The vehicle sends to the receiver when it collides with the sensor. As a result, the motor is able to rotate, and it also tilts the nails. The LED in it illuminates when the infrared sensor detects a vehicle.

RF TRANMITTER AND RECEIVER MODULE:

The 434 MHz frequency is used by RF transmitters and receivers to send signals from one location to another that include data. Police, fire, and ambulance vehicles employ RF transmitters and receivers. The receiver will be linked to a Raspberry Pi module, while the transmitter is currently attached to a battery. The RF transmitter is mounted in the cars. When these cars are hit by another car, the transmitter manually transmits the information to the receiver; this allows the traffic light to turn green and sends the cars there right away. In this manner, individuals in critical condition might have their lives saved by emergency vehicles.

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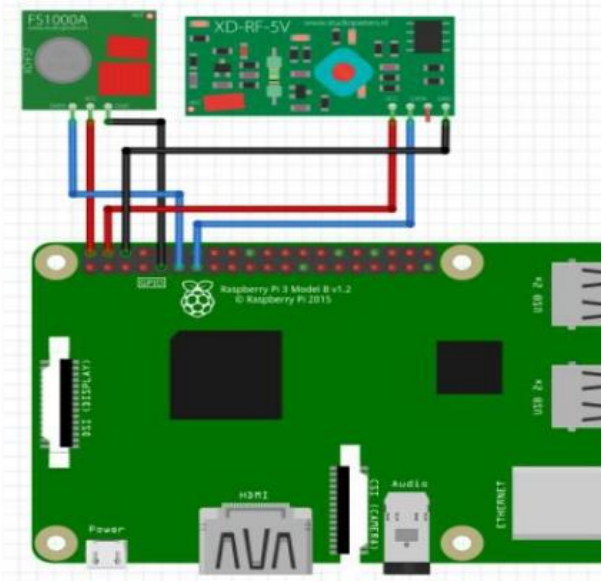

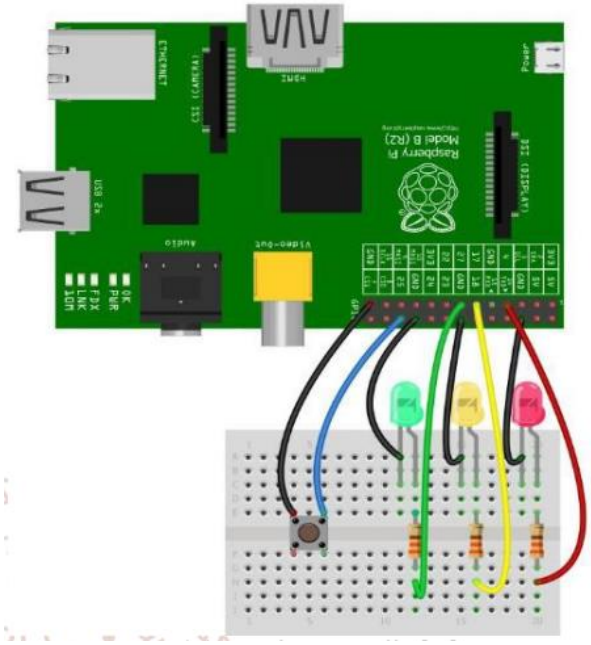

TRAFFIC LIGHTS:

Traffic lights are used to control the vehicle congestion. These lights are operated with the help of raspberry pi which controls the system. When the vehicles are more on the road then green light will be allowed for some time and then the red light will glow after the road has less vehicles on it.

IV. RESULTS:

A novel approach to vehicle detection and extraction in traffic surveillance situations is shown. This system uses an innovative background subtraction technology to locate moving objects in intricate road sceneries. The novel approach relates to a histogram-based filtering process that gathers pixel-by-pixel scatter background information conveyed in a sequence of frames to produce consistent examples of the true backdrop. Under every traffic situation, the suggested technique reconstructs a background instance on demand. Detecting moving objects from the difference between the current frame and a reference frame—often referred to as a "background image" or "background model"—is the logic behind the method. Most often, background removal is carried out when a picture is a component of a video stream. Important clues are provided by background removal for many computer vision applications, such

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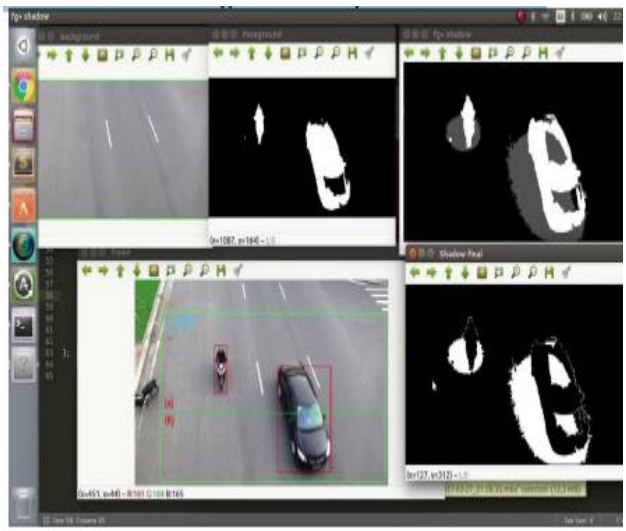
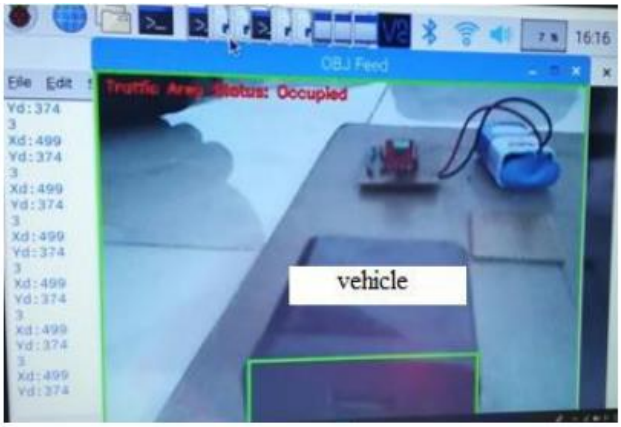
as monitoring surveillance or estimating human postures.





CONCLUSION:

We created a density-based traffic management system utilising a Raspberry Pi, an IR sensor, a camera module, and image processing in response to the traffic congestion in metropolitan areas. At the beginning of the road is where the camera module is located. This provides the number of cars on the road; with that number, we may manage traffic by permitting cars in areas with higher densities. Better traffic management flexibility is offered by the technology. By sending out the signal, the ambulance's details are also sent, and a green light will appear on the road. The nails attached to the motor will cause harm to the car if it attempts to cross the road at a red signal. A density-based traffic signal management system is effective in reducing traffic in cities and the amount of time people spend stuck in traffic.

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