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AI BASED TRAFFIC SIGNAL CONTROL SYSTEM

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Abstract - *The control system of the traffic light is mainly used to monitor and control the flow of vehicles through the intersection of roads. The main purpose of our system is the smooth movement of cars along the transport line. Integrating a system with multiple traffic lights into an existing system is a complex task. The existing system does not control the flow of the vehicle to the node. There is no common abstraction between traffic light systems, vehicle deviation, high red light delay, vehicle drift, accident, emergency vehicle and pedestrian crossing. The existing system leads to congestion. We recommend an Arduino based system with image processing for measuring traffic density. At the traffic light, an image processing system is used, in which the Arduino regulates the synchronization of the signal based on the counting of vehicles. Controls the next signal based on the previous display. The portable device is designed to solve urgent problems stuck on crowded roads. MATLAB is software that has a number of image processing functions.*

***Key Words*: Traffic light system, Arduino, Image processing, Camera, Vehicle counting, traffic density.**

1. INTRODUCTION

A traffic light system developed since 1912 to control traffic at intersections, pedestrian crossings and other areas. Traffic jams are increasing day by day, so we have to face many problems. Due to the large volume of vehicles, the lack of infrastructure and distribution systems is the main cause of traffic congestion. Traffic lights are red, blue and green. The green light signal is used in the indicated direction; the yellow light signal is used to warn cars of a short stop and a red light prohibiting movement.

These days, many nations suffer the ill effects of the traffic congestion issues that influence the transportation system in urban communities and cause genuine difficulty. Despite supplanting traffic officers and flagmen via programmed traffic frameworks, the advancement of the overwhelming congested driving conditions is as yet a noteworthy issue to be confronted, particularly with different intersection hubs. The quick increment in the number of autos and the always rising number of street clients are not joined by advanced frameworks with adequate assets. Halfway arrangements were offered by developing new streets, executing flyovers and sidestep streets, making rings, and performing streets restoration.

The traffic issue is extremely muddled because of the contribution of assorted parameters. In the first place, the traffic flow depends upon the time where the traffic top hours are for the most part early in the day and toward the evening; on the times of the week where ends of the week uncover least load while Mondays and Fridays by and large show thick traffic arranged from urban communities to their edges and in turn around bearing individually; and time as occasions and summer. Also, the current traffic light system is executed with hard-coded defers where the lights change schedule slots are settled routinely and don't rely upon continuous traffic flow. The third point is worried about the condition of one light at a crossing point that impacts the stream of movement at neighboring convergences. Additionally, the traditional traffic system does not think about the situation of mischance, road works, and breakdown vehicle that compound movement blockage. Furthermore, a pivotal issue is identified with the smooth movement through crossing points of crisis (Emergency) vehicles of higher needs, for example, ambulances, rescue vehicles, fire brigade, police, and VIP people that could stall out in the crowd. At long last, the walkers (pedestrians) that cross the paths also modify the traffic system.

The traffic light system should be moved up to fathom or upgraded the extreme traffic congestion, mitigate transportation inconveniences, diminish traffic volume and holding up time, limit by and large travel time, advance vehicles security and effectiveness, and grow the advantages in health, economic, and natural segments. This paper proposes a simple, minimal effort, and constant savvy traffic light system that means to defeat numerous deformities and enhance traffic administration. The system depends on Arduino microcontroller and PC camera, which uses for continuous capturing the vehicle images on roads and perform the action to solve the congestion problem in traffic light system.

2. LITERATURE SURVEY

[1] Introduces a two-stage processing method: vehicle detection and vehicle detection. First, a machine learning algorithm based on functions similar to those of the Haar and Ada-Boost algorithms is used to train the classifier to detect vehicles in the input image, which allows recognition of the image of interest (ROI). Then additional training is carried out using the basic component analyzer to learn how to recognize the different types of vehicle samples. Density based traffic signal system.

[2] Traffic control at a roundabout. It discusses the differences between system setup and vehicle recognition, tracking and routing systems and all technologies based on driving vision in a car. Recently, all directional cameras and parameters set by man are used in roadside systems, but they are faced with automation problems. Technologically integrated vehicles use light detection and ranging systems, as well as radar and stereo systems, which is a continuous overview. In the recent side system literature, vehicle tracking is primarily based on a rare feature combined with the Canada-Lukas-Tomasi settlement algorithm. In addition, relocation, modeling and prior knowledge are necessary for the exact location of the site and the correct classification of participants. When used in vehicles, the first goal is to precede or close the vehicle. Traffic signs are mainly used for various adaptations of the optical data stream. When a vehicle is detected, it is usually followed by general Bayesian algorithms, especially Kalman and particle filters. The latter optimized optical catadioptics and arc optics for the entire controlled vision is used.

[3] The main idea of the proposed system is the effective use of observation systems using image processing methods. The step of the intellectual surveillance system is video. To record, extract frames from a video input, apply a Gaussian blur using Gaussian blur, use a blur, also called Gaussian smoothing. This is a Gaussian matrix calculation that is smooth or blurry to reduce image noise. After applying the Gauss function, the system is divided into two parts: recognition of abandoned objects and recognition of a person. When detecting abandoned objects, suspicious objects are recognized by extracting the background, determining thresholds and clots. When human spots are detected, red blue green transforms into light and color measurements and thresholds. The main and only drawback of this system is the need to update the background when changing the background.

[4] Implements an intelligent flow control system that allows you to move ambulances. Each vehicle has a special RFID tag (located in a strategic location) that prevents removal or destruction. RFID readers, NSK EDK-125-TTL and PIC16F877A systems are used to read RFID tags attached to a vehicle. It calculates the number of vehicles traveling along a given route for a specific period of time. It also determines the network load and thus adjusts the green light time. Automatic check of routes based on traffic density, allowed the police effortlessly and reduced their overhead. Since the entire system is automated, it requires much less human intervention.

[5] Implements RFID (Radio Frequency Identification) and Record Identification (NPR) systems for vehicle identification and control. License Plate Identification (NPR) is a truly embedded system that often recognizes a vehicle's license plate. Intersection systems are used only to identify the vehicle. The license plate (NPR) and control system are identified by a combination of image processing and RFID and are used to identify and authenticate the vehicle. Smart traffic system control and traffic avoidance system during emergencies using Arduino and ZigBee 802.15.4 is used. The selected text is then used for authentication, and the RFID information is used for verification. Image recognition methods, such as image capture, binary transformation, segmentation, pattern generation, and matching, are used to identify and control the vehicle. The work of both modules is parallel. The challenge is to recognize the characters.

[6] Demonstrates machine aggregation of vehicle characteristics (traffic) to control a system widely used to prevent identification of a vehicle, ambulance and hijacked vehicle. Each vehicle has a radio frequency identifier (RFID), which identifies the signal of the vehicle aggregation (traffic). The RFID reader expects vehicles to move along a given route for a certain period of time. Depending on the number of vehicles, if the vehicles (movement) are detected by an infrared sensor, the green light comes on and the vehicles spread evenly. If the RFID reader reads the stolen vehicle, a police message is immediately sent to the control room using the mobile subscriber module 300. In addition, if the hospital car passes through ZigBee and Atmega328, as indicated by the vehicle (traffic), the message will be redirected to the vehicle's resources (traffic) so that the controller turns green. The microcurrent Atmega328 is directly connected to the individual vascular components and acts as a central point.

[7] It presents three main objectives and notes the speed of the vehicle, marking them with paint and creating an economical and simple system. In this case, the ultrasonic sensor detects temporary vehicles and sends data to the Arduino. He then examines the Arduino and responds through a relay mechanism to a gun equipped with a solenoid valve. Arduino provides programmed more accurate results. It also states that the prototype system can effectively detect and signal rapid acceleration. The result shows that this innovative technology improves the reliability of the road safety system. By performing these functions in real time, you can avoid accidents up to 70%.

[8] Represents a system that identifies a unique RFID tag for each vehicle, and each vehicle's identification data is entered into the police database. The RFID reader reads the tag values, and this value is provided by the Raspberry Pi processor. RFID can be provided to hijack a car by selecting a browser that serves to enter the Raspberry Pi. Raspberry Pi compares the details of already saved RFID tags with dynamic tags. When they match, they take a snapshot of the vehicle and send it to a specific mailbox. The camera is connected to the Raspberry Pi processor. The Raspberry Pi processor saves image data on an SD card (hard disk). It uses the Internet of Things and RFID, which connect various smart devices that provide security when stealing a car.

3. EXISTING SYSTEM

The traffic lights system utilized in India are essentially pre-planned wherein the season of every path to have a green signal or light is settled. In a four-path traffic signal, one path is given a green signal at any given moment. Along these lines, the traffic light enables the vehicles of all paths to go in a grouping. In this way, the activity can progress either straight way or turn by 90 degrees. So regardless of whether the activity thickness in a specific path is the minimum, it needs to sit tight superfluously for quite a while and when it gets the green flag it pointlessly makes different paths sit tight for significantly longer lengths. Numerous techniques had me acquainted with take care of the issue of activity utilizing sensor and fluffy rationale strategies, but the issue constant illuminating the issues is still tested. This issues can overcome by utilizing Digital Signal Processing Technique i.e. image Processing.

4. PROPOSED SYSTEM

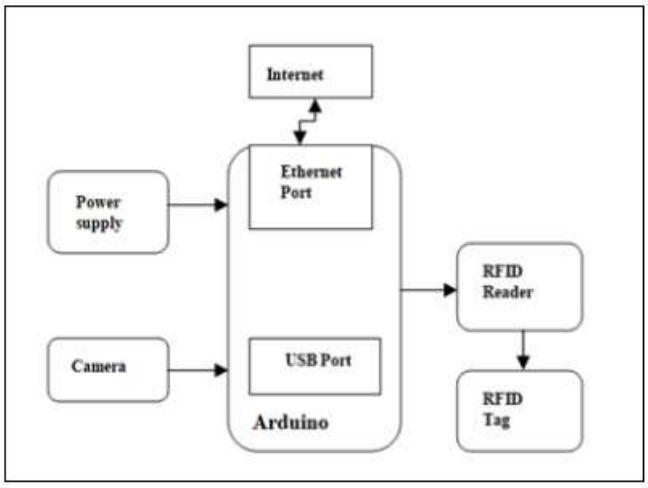

Fig -1: System Block Diagram

The functions of the various components are given below:

USB Camera: USB Camera captures the image and sends it to the USB port of the Arduino Uno board. The camera model used here is USB Camera model 5.0.

Arduino: Arduino is an open source platform used to Design electronics. Arduino embodies a physical board (often called a microcontroller) that is programmable and a piece of software or integrated development environment (IDE) used on computer to write and download computer code on a physical board.

RFID Reader: An RFID reader (RFID Reader) is a device used to collect information from an RFID tag used to track individual objects. Radio waves are used to transmit data from the tag to the reader.

RFID Tag: An RFID tag is an electronic tag that communicates with an RFID reader via radio waves.

Thingspeak Application: Sending notification with embedded system was a problem with few solutions, widespread was SMS but other side there are some issues of extra payment, limited number of data, etc. Thingspeak provide push notification from cloud after getting registered on thingspeak website. In this system, the image is captured via USB camera, and programming is performed in the Embedded C language and Arduino Integrated Development Language. Whenever an RFID sensor detects a signal, it sends a positive signal to the Arduino. The RFID recognizes the signal and sends the output signal to the USB camera to capture the image.

Block diagram for traffic light system for the real time traffic management system which overcome the drawback of previous standard methods. The vehicle is detected by the framework using image instead of sensor. A camera is placed apace with the traffic light. It takes the image or captures the image. To control the change of traffic lights, technique of image processing is used. Through this amazing technique, the traffic will decrease and abstain from the amount of time being deteriorated by green light signal on the vacant road. In proposed system emergency vehicle is detect on any rout that time system send the signal to controller to clear that road or traffic i.e., green signal is gives to that road. This system is also more efficient and reliable in assessing the presence of vehicles on the road, since it uses a system of actual traffic density. Hence with the additional of these techniques proposed system is more effective that existing system.

5. METHODOLOGY:

5.1 Image acquisition

In general, an image (image) is a two-dimensional function f (x, y) (here x and y are flat coordinates). In addition, it is also called gray level image (s). These x and y values need to be changed to limited discrete properties to create a digital image. The input image is a database from a stunning database and drive database. An image of the retina is made to prepare and monitor the condition of the person. For processing on a PC, the analog image must be converted to a digital image. All extended images made from limited components and each limited component are called pixels.

5.2 Image cropping

The second step is to select a focused area, structuring the cut calculations in MATLAB. The motivations for editing is to recognize the street (path) where there are vehicles and prevent meaningless source data. This meaningless data is located in each frame of captured images.

5.3 Image matching

Recognition procedures depend on the compliance of the sample vector of the sample corresponding to each class. An indefinite example refers to a class that is closest to a predefined metric. The least complex methodology is the

main classifier-separator, which, as its name implies, excludes computers (Euclidean) between the blurry and all model vectors. You choose the shortest distance for your choice. There is another relationship-dependent methodology that can be directly identified with images and is very instinctive.

5.4 Image scaling

Image scaling occurs in all computerized photos at some stage, regardless of whether it is in the Bayes demo tape or in the design of photos. This happens whenever you change the image size from one pixel to another. Image resizing is fundamental when you need to increase or decrease the total number of pixels. Regardless of whether a similar image size is reproduced, the result may vary significantly, relying on the calculation.

5.5 Image enhancement

Image enhancement is a way to modify advanced images to make the results more suitable for exposure or further study. For example, we can reject noise, which will make less demanding recognition of key qualities. On bad images of differentiation, nearby characters melt in the midst of a binarization and it is necessary to reduce the scatter of characters on which previously imposed restrictions on the word "picture".

5.6 Color detection

The idea of defining color, as the name itself recommends, is part of image processing, which involves the separation between elements depending on their color. If we work with an image of different colors and we need to process only certain colors, at this point the color matching strategies essentially return a parallel image, where only the bits with the important color are white and the output color is black. This reduces the image data only to raster images, which makes them less demanding for processing for various tasks.

5.7 Blob detection

Blob detection methods have dematerialized to discern areas in a digital image that differ in properties, such as luminosity or color, in contrast to the concealing areas. There is a certain range, which shows that the protest will be additionally checked if it exists in the range, or will be considered a pictorial image and pass through it.

5.8 Object counting

To read the elements in the picture, the nearby borders of the articles are different. The outer boundaries of the object, in addition, the open borders within these products in a parallel image are classified to distinguish between vehicles that are available in a focused area.

5.9 Traffic density

The next step is to calculate the mass of the car on the road in the target zone. The signal is triggered by traffic jams. The system changes the signal when there is a large amount of car on the tape. The system captures images from the tape and makes a decision to change the traffic signal depending on the traffic density on the tape or path.

5.10 Background Subtraction

Background subtraction is a widely used approach for detecting moving object video from still cameras. The reason for this approach is to detect moving objects of the difference between the current frame and the reference frame, often referred to as the background image or background model.

5.11 Support Vector Machine

In SVM algorithm, find the points closest to the lines of both classes, which are called support vectors. Now calculate the distance between the line and the support vectors. This calculated distance is the margin. Main aim is to maximize the difference. The optimal hyper plane is the one in which this margin is maximum. SVM is therefore trying to make the decision boundary so that the distance between the two classes is outspread.

6. WORKING MODULE

1. Arduino UNO, which controls the camera to capture all or part of the image strip, is used. Recorded images will be sent to MATLAB for processing.

2. MATLAB stops image processing, and the priority of each band is to determine traffic density. Traffic density must be determined for each IN road section.

3. A line or path with a higher traffic density receives a first priority, and a path with a lower traffic density is the lowest priority.

4. The road is selected in order of decreasing priorities.

5. The time of each signal depends on the OUT bands or traffic density in descending order.

6. When all the lane or route has given the green signal based on their priority the traffic system complete its one cycle. This process will be repeats and time for all signals will be given on the basis on traffic density.

7. PROPOSED ALGORITHM

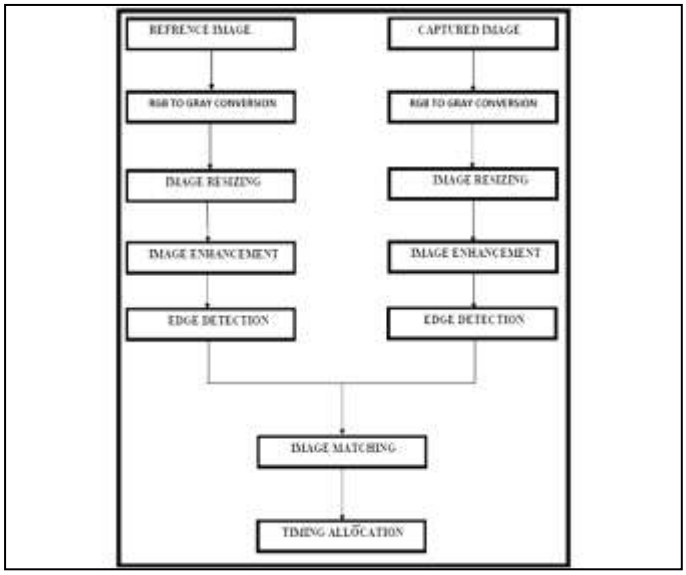

Fig -2: Traffic Signal System Algorithm

8. MATHEMATICAL MODEL

1. Input Vehicle Count
   I = {i1, i2, i3, ...in| Where I is the vehicle count'
   } i1,i2, i3,.in are the words of string.
2. Identify count on signal
   S = {s1, s2, s3, ...sn | Where, S is the main set of counts.' }
3. Identify features
   F = {f1, f2, f3, fn | Where, F is main set of
   features(Emergency vehicle /Normal Vehicle' }
4. Identify Classification
   C = {c1, c2, c3, fn | Where, F is main set of emergency
   vehicle Classification depend on signal' }

Classification of Emergency or Normal vehicle

If f1∈ Σ c1,c2....cn

C ⟵f1

.

.

If fn ∈ Σ c1,c2....cn

C ⟶fn

Where f1,f2 = extracted feature

C= classification group

Calculating Time

Pi=fi/Fx

Where

Pi=polarity of vehicle

fi=feature of vehicle(emergency/normal vehicle)

Fx=total number of features

9. RESULTS

Traffic Light	Red	Yellow	Green
1	0	1	0
2	1	0	0
3	1	0	0
4	1	0	0

Table -1: Signal Processing

Initially, all signals at a particular junction will turn yellow and as the traffic increases the signal will start turning green in sequence. The normal flow of traffic shows that signal 1 will turn green first, and then signal 2 followed by signal 3 and at last signal 4. The order of the traffic lights began as a green light that lights up at traffic signal 1, and the red light of other traffic lights. Each vehicle has been given 2 seconds time to pass through the particular signal. The duration of this mode lasted a few seconds and it depends on the camera image capture.

Then the sequence turned on the green light of traffic light 2 and the red light of other traffic lights for few seconds. The same thing happened with traffic light 3 and traffic light 4 after the yellow lights of each traffic light turned on for a few seconds. The microcontroller constantly repeats this light, if the emergency order is not activated.

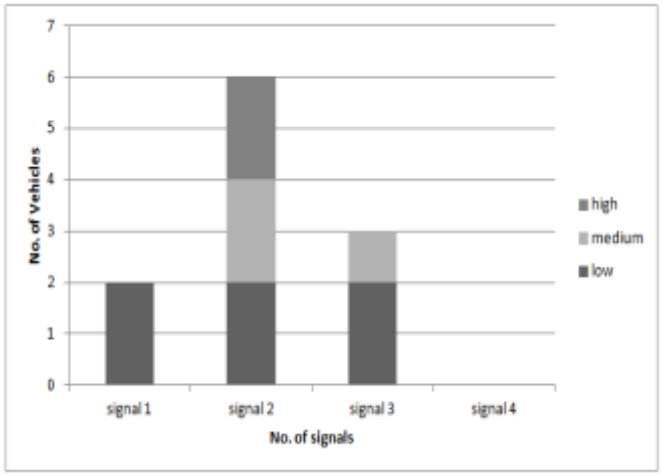

Chart -1: Vehicle Priority, Emergency and Count Results

In the graph above, there are three sectors available according to the number of vehicles. In the above pictorial representation, the maximum number of vehicles is six and minimum number of vehicles is zero. Zero to six numbers also represents the count of vehicles and 0-2 represents low priority, 2-4 represents medium priority and 4-6 represents high priority. So at signal 1, the count of vehicles is 2, at signal 2, count of vehicles are 6 and at signal 3, the count of vehicles is 3. In this case, signal 2 has maximum number of vehicles so there is traffic congestion and so the signal for signal 2 will turn green and all other signals will turn red. Also, signal 4 is considered a road with no vehicles, if there is more traffic then vehicles will go through that signal or path to make way for emergency vehicle and after that it comes

back to normal. RFID is used to detect vehicle and keep a record of the passing vehicle.

10. CONCLUSION

This paper presents a strategy for evaluating traffic systems using image processing. This is eliminated when using images taken from a carriage or tape, and recorded images are moved into a series of images. Each picture is prepared independently and the number of the vehicle is collected. If there is no chance that the number of vehicles will exceed the established limit, a notice of significant movement will be indicated automatically. In the proposed system, the key feature is ambulance priority. The advantages of this new method include such advantages as the use of image preparation in comparison with sensors, simplicity, and ease of setup and, as a rule, high accuracy, low price and speed. Since this method is implemented using MATLAB image processing and programming, the cost of production is low, with high speed and better performance for accuracy.

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