Intelligent Traffic Management Systems Using Image Processing Techniques

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Abstract The world's population and the multitude of cars on the road today are both gaining popularity. Most countries in the world are currently experiencing traffic congestion. Ineffective traffic management, which results in regular traffic congestion at major intersections, is one of the major causes of such issues, which includes environmental pollution, traffic injuries, health losses, and time wasted. As a result, to efficiently control traffic congestion on streets, highways, and roads, a successful management system is required. The aim of this study was to compare and contrast various traffic electronic systems and their feature extraction techniques in order to effectively manage pollution level. Based on data from video camera images of roads and image processing techniques used to monitor traffic road traffic congestion, we constructed a framework for a traffic management system.

Keywords: Congestion throughout the roads, Intensity of Movement, Method of Smart Transport, Identification of the edges, Enhancement of Image

I. INTRODUCTION

Because as population of urban cities grows, the amount of cars on the road grows in lockstep, resulting traffic congestion. In places or areas with a highly populated, heavy traffic causes several of the opportunities and risks, involving wasted time, fuel, and funds. Special events, construction, unpredictable incidents, weather, time, day, and season are all factors that affect traffic load. Additional delays which occur if these criteria are not taken into account in traffic control system. New roads are often designed to relieve heavy traffic congestion [8]. New highways, on the other hand, have the ability to make the surrounding areas rather more overloaded. Highway systems, as we all know, are the backbone of many countries' economic growth and development. As a result, having a reliable, fast, and cost-effective traffic management system is critical for national growth. To combat the huge increase in the number of cars on the road today, a suitable traffic sensor network must implement advanced innovations. In the current research, Because of their ease of implementation and applications for effectively improving traffic flow in the current transportation system, we looked into automated and adaptive control systems. In addition, because of scarce resources, intelligent traffic control systems are expected to become more effective for traffic management [1].

Different traffic calming strategies are available to alleviate traffic congestion at a busy intersection. There is no ideal strategy for rapidly evolving real-time conditions. Here, we'll look at a few traffic control strategies that can be used to deal with constantly evolving real-time traffic. Our suggestion is based on various observations of traffic on the road from obtained images: A red light shows that now the road is empty, while a green light shows that traffic is heavy. We can adjust the time of the green light depending on the traffic intensity from here.

So that, with careful management, we can be able to solve the problems of heavy traffic. The main objective of the intelligent traffic management system that we implemented through METLAB for this research is to understand decrease vehicle path waiting period.

II. PRIMARY CONCEPTS

A. Encryption of images

An RGB image is converted to a gray image using an image encryption technique. The term "encrypted image" is often used to refer to a cipher image [1].

B. Decryption of images

The transfer of an encrypted image back to the original image is what an image decryption technique does [1].

C. Image Processing in Digital Format

A two-dimensional function f is used to define an image (x, y). When the intensity and amounts of the dimensions x,y are finite and discrete, it is referred to as a digital image. Image processing in digital format requires the manipulation of digital images using a computer. Segmentation of data, extraction

of features, detection of the edges, image morphology, recognition of patterns, and other digital image operations are included in this technology [2].

D. Enhancement of Image

The picture was recorded in RGB format. The RGB image must be converted to a grayscale image. To accomplish this, proper thresholding during binary conversion is needed in order to present the image in contrast to its context. This is referred to as image enhancement. The objective of image optimization techniques is to represent the information so that the processed image is better suited for the requirement than the main image [4].

E. Congestion throughout the roads (Traffic Congestion)

The slower speed of cars traveling on the road causes traffic congestion, which results in longer travel times and more car queues or traffic jams. Congestion can be caused by a number of causes, such as road closures due to accidents, which decreases traffic flow quality. Furthermore, inadequate road construction or design may reduce traffic power. When a large number of cars exit a stadium, market, or cinema hall at the same time, traffic can increase, which is a common problem in large cities. Congestion can also cause stress or irritation in drivers, potentially leading to traffic accidents [1].

F. Identification of the edges (Edge Detection)

One of the most important aspects of image processing is edge detection. The edge of an image is an interesting component, but there are a variety of feature extraction techniques for extracting edges from digital images, as can be seen in Figure 1.

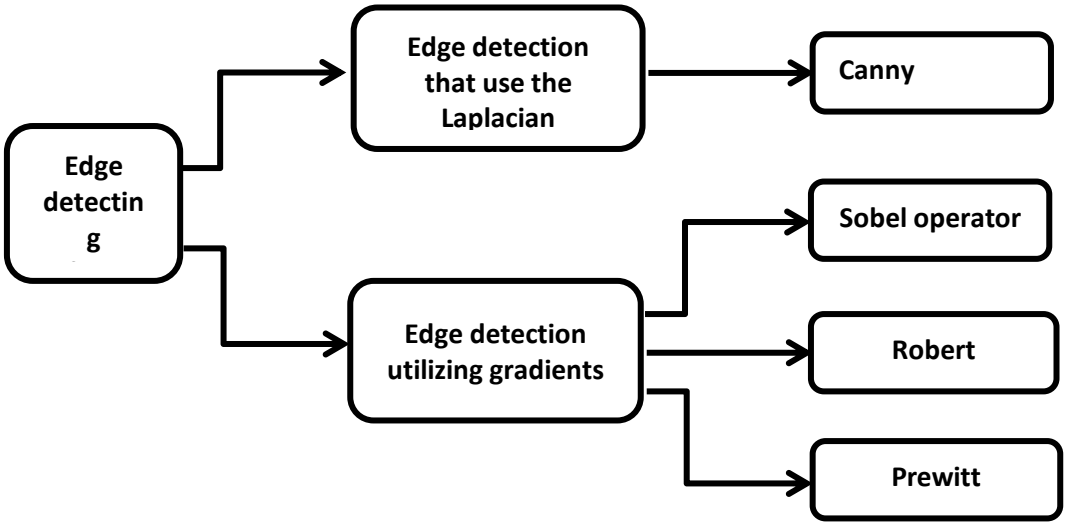

Figure 1:- Edge detection software

The edges of an image are defined by edge detection. Edges are usually found at the intersection of two separate regions in an image. Edge detection helps the viewer to see the areas of a picture where the gray level suddenly changes, signaling the end of one area and the start of another. Satellite images, facial detection, diagnostic imaging, computer driven surgical treatment, thumbprint identification, automated traffic monitoring, as well as other applications of this technique are popular. The issue of image enhancement is explicitly addressed by feature extraction techniques [3], [8].

G.Traffic Density

The interaction between drivers and road systems is known as traffic flow. This project aims to comprehend and establish a proper transportation network with a high level of productivity due to efficient traffic flow and minimal traffic congestion concerns. Vehicles per mile per kilometer are the total number of vehicles that fill one mile or one kilometer of road space [2], [4].

H. ITCS

A traffic control is a mechanism that manages traffic delays by effectively managing and modifying, and an Intelligent Traffic Control Is a mechanism that adjusts the signal timing lights to the actual vehicle density. The benefits of introducing Intelligent Traffic Control Systems include reduced congestion, lower fares, the availability of alternative routes for passengers, and improved infrastructure performance. Image enhancement

techniques such as edge detection can be used to find the traffic density in one such traffic control system, and systems based on traffic density can regulate traffic light signals [1], [3].

I. Intelligent Transport System (ITS)

An intelligent transportation system (ITS) is a moderate technology that is designed to even provide innovative new services for a variety types of traffic control while still allowing people to ever be properly informed about protected and smart traffic management. ITSs increase the reliability of the transportation system by alleviating traffic congestion on dangerous roads [6].

Car control, traffic signal control systems, container management systems, various message signals, automatic vehicle number detectors, or digital cameras for continuous surveillance, such as Closed Circuit Television, can all be used as part of ITSs (CCTV), advanced smart systems that incorporate real-time data and input from a variety of sources, such as parking assistance systems and weather forecasting data In order to improve safety, efficiency, and performance, ITS entails the detecting, study, management, and communication of relevant road transportation data. These systems can be used in a variety of situations, such as the processing and sharing of data on heavy traffic conditions, enhanced traffic management, reduced energy consumption, and increased transportation system advantages to commercial and residential customers [1].

III. PROPOSED WORK

We are attempting to implement an intelligent traffic management system utilizing simple techniques associated with computer vision throughout this system. Next, we'll have to get some pictures of major roadways. To calculate the traffic density, these images are processed using MATLAB code. The module produces collection and measurement on the processed picture and road intensity, which indicate the length of the traffic light signals. Depending on the traffic density on the street, the length of the whole signals can be raised or lowered. This technique is utilized first by conducting image acquisition, then image encoding, which includes RGB to gray conversion. After that, image enhancement is carried out. The similarity to the main image is required for the successful reorganization of the image. Finally, to match the image, edge detection is used.

IV. BLOCK DIAGRAM

The model's specifications are classified into three categories: mechanical model, application model, and integrations. The block diagram is made up of many sub-blocks, including a video camera, a personal computer, a power source, an LED device, an LCD, and infrared sensors.

The recording device serves as a camera sensor, recording objects in actual environments. The personal computer (PC) analyses various digital data. As a result, the PC plays a very important part in the monitoring system, comparable to something like a centralized controller. This central controller performs a number of image processing functions. One of the importance - performance tools for this is MATLAB.

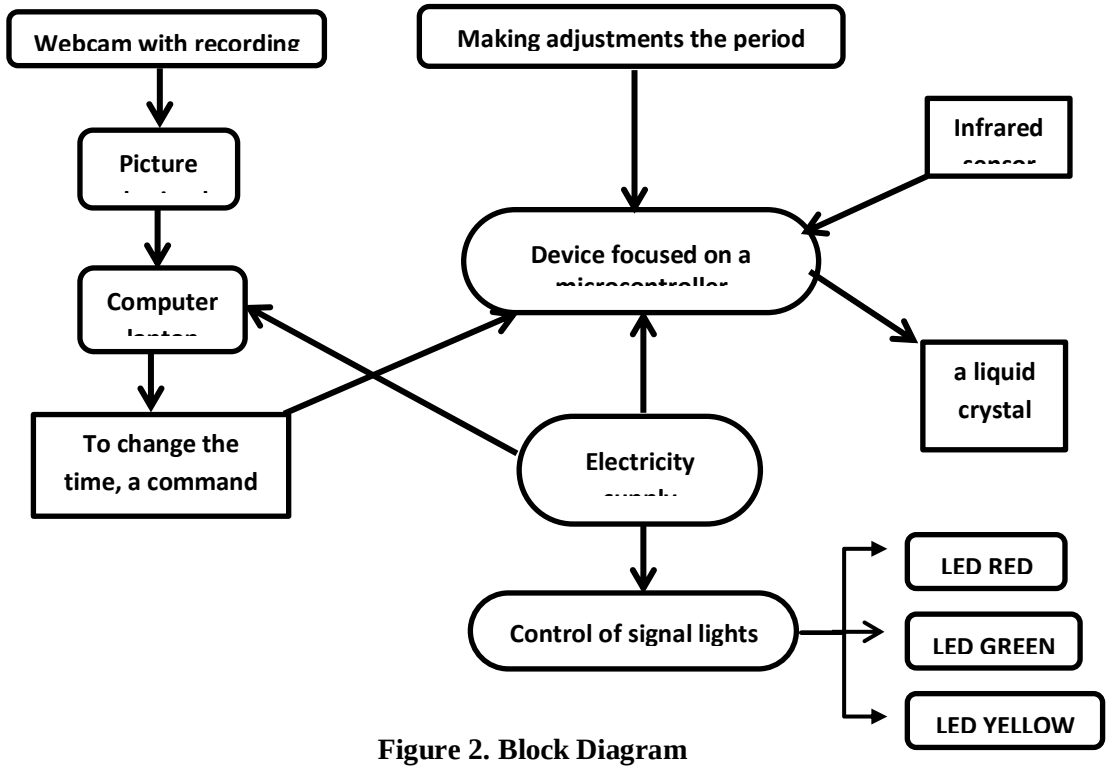

Figure 2. Block Diagram

The signal flow can be seen in the block diagram described. The most serious traffic congestion happens at the main intersection, wherever multiple streets cross. The video recorder that is constantly documenting at this point records images of road traffic. These images will be sent to Computer operating MATLAB software that serves as the system's microprocessor. Pictures first were encoded before being converted to gray scale. The pictures have been further analyzed to measure traffic density using an edges detection technique. The number of vehicles is determined by comparing each obtained picture to one source images, which is a picture within each road without any vehicles on it. The machine generates an instruction dependent on that result. The length of the green light is extended on roads with high traffic intensity. Comparably, on a road with little traffic, the period of the red light is lengthened. Adapting the period of red and green indicators based on traffic intensity results in avoiding highway traffic congestion. The interval modification instructions are sent to a microcontroller device, which performs the auto-switching of red to green. The power source generates electricity to every unit according to its needs. The IR sensor is critical in the event of any collision that is discovered to be restricting the highway. The IR sensor's signaling enables the controller to show pre-alert "avoid accidents" messages on the LCD.
All this traffic signal shows that we can effectively solve road congestion issues by introducing systems with smaller image processing software.

Simple Computational Expression Method

A digital camera can capture the images.

1. Take the photo whenever the street is completely clear (i.e. no traffic).
2. In certain software, the blank street picture should be used as a source images.
3. The reference image has been encrypted (i.e. RGB to Gray Conversion).
4. Have the gamma-corrected optimal outcome of the source images.
5. The edge detection of the source image is performed using the Prewitt edge detection algorithm.

Now take a view of the road with traffic.
Then, in a sequential manner, encode the image information, i.e. perform RGB to Gray Transformation. Improve the image data and identify the edges of these actual images obtained. Otherwise you can measure traffic density and monitor traffic lights proportional to the number of traffic density by comparing or matching the real-time picture with the source images [4],[5].

V. ADVANTAGES AND DISADVANTAGES OF SMART TRAFFIC CONTROL SYSTEM

The use of traffic control signals helps in an orderly flow of traffic. Accidents are minimized as a result of introducing the smart traffic control system. It reduces traffic congestion at busy intersections and ensures safe city driving. Time, power, and money are all saved when there is no traffic. As a consequence, pollution has a lower impact on the atmosphere. Since existing roads are well-used, and have no need to create new ones. The installation of the machine must be performed correctly. Minor differences in the software code can have a major effect on how the process works. As a result, the central unit's protection is needed [6], [7].

VI. CONCLUSIONS

The intelligent traffic signal control algorithm is constructed using computer vision techniques, which are reviewed in this paper. One of today's big issues is traffic congestion. Day after day, because as world's population grows, so do people's everyday requirements. A fast-growing environment necessitates the use of cars, that results in an increment in the amount of cars on the road today. In large cities, a clever traffic signal control system is needed. The system under discussion is straightforward and effective. There is no need for any additional costly hardware or software. The materials used to put this device in place are readily available. The intelligent traffic control system is, on the whole, efficient. Mostly with help of new technological innovations, we will upgrade this product to improve 100% performance and quality.

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