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SMART TRAFFIC CONTROLLER USING IMAGE PROCESSING

Rushabh V. Kulkarni[1], Saurabh R. Bhadane[2], Prathmesh A. Gardi[3]

[1]BE Electronics and Telecommunication Engineering, Dypcoe Akurdi, Pune, Maharashtra
[2]BE Electronics and Telecommunication Engineering, Dypcoe Akurdi, Pune, Maharashtra
[3]BE Electronics and Telecommunication Engineering, Dypcoe Akurdi, Pune, Maharashtra

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Abstract - *The frequent traffic jams at major junctions call for an efficient traffic management system in place. The resulting wastage of time and increase in pollution levels can be eliminated on a city-wide scale by these systems. The project proposes to implement an intelligent traffic controller using real time image processing. The image sequences from a camera are analyzed using thresholding method to find the density. Subsequently, the number of vehicles at the intersection is evaluated and traffic is efficiently managed. The project also proposes to implement a real-time emergency vehicle detection system. In case an emergency vehicle is detected, the lane is given priority over all the others. Hardware control is done by microcontroller. This project also describes an Automatic Number Plate Recognition (ANPR) system designed to detect the vehicles that violate traffic signal by extracting their number plate from digital images. Further, it sends a violation SMS to the owner of the vehicle immediately. The proposed system inputs the captured image of the vehicle. The image segmentation techniques are used to extract the number plate region. Correlation technique is used for comparing the segmented image with the template images. The resulting data is then used to compare with the records in the database*

Key Words: Intelligent traffic controller, real time emergency, microcontroller, ANPR- Automatic Number Plate Recognition, segmentation, etc.

1. INTRODUCTION

Automatic number plate recognition, ANPR, is a mass surveillance method that uses optical character recognition on images to read the license plate on vehicles using existing closed-circuit television cameras or road-rule enforcement cameras, or ones specifically designed for the task-some systems commonly use infrared lighting to allow the camera to take the picture at any time of day. They are used for various tasks, including electronic toll collection on pay per use roads, restricted car identification access control schemes such as for pay parking-lots or for secured office compounds, monitoring traffic activity such as red-light adherence in an intersection and for direct marketing. ANPR technology tends to be region specific, owing to plate variation from place to place. The first ANPR was invented in 1976 at the Police Scientific Development Branch in the UK.

1.1 Objectives

[1] To successfully implement a responsive traffic signal control system by measuring the traffic density using. Image processing by MATLAB and ATMEGA 16 controller to control the traffic signal.

[2] It is required that an automated license plate recognition system be designed and implemented. The system takes digital images of vehicles with their license plates visible and extracts license plate characters as a string of alphanumeric characters, and yields hypothetical user data from a related database corresponding to the extracted characters as output.

1.2 Problem Statement

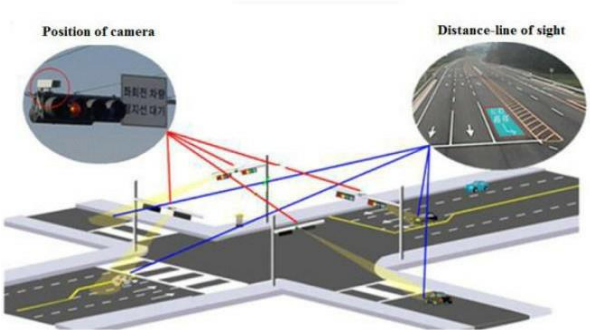

Fig -1: Proposed Traffic System

Conventional traffic controller uses pre-defined time to control the duration of signal in one particular direction or in some places human physically have to do the job. While their system is somehow convenient but isn't efficient and, in some cases, costly since large human forces is required to maintain traffic rules as well as traffic congestion control. We purpose system which will tackle above stated problems using Image Processing.

2. Literature Survey

Pallavi Choudekar, Sayanti Banerjee, M.K. Muju [1]- This paper proposes a system for controlling the traffic light by image processing. A camera will be installed alongside the traffic light. The image sequence will then be analyzed using digital image processing for vehicle detection, and according to traffic conditions on the road

traffic light can be controlled. In the present work the designed system aims to achieve the following

[1] Distinguish the presence and absence of the vehicle in road images

[2] Signal the traffic light to go red if the road is empty.

[3] Signal the traffic light to go red if the maximum time for the green light has elapsed even if there are still vehicles present on the road.

Vikramaditya Dangi, Amol Parab, Kshitij Pawar & S.S Rathod [2]- The comparison of various edge detection algorithms, resulted that Canny Edge Detector technique is the most efficient algorithm.

Khan Muhammad Nafee Mostafa, Qudrat-E-Alahy Ratul [3]- This paper suggested the use of automatic traffic detection system is required for smooth and safe living which directly leads us to proper adjustment and controlling of traffic system.

Prof. Uma Nagaraj, Jinendra Rathod, Prachi Patil, Sayali Thakur, Utsav Sharma [4]- from this paper we can suggests that the analysis can be improved with the use of multiple sequential cameras along a highway which along with localized congestion control, analyzes the congestion build up from the start to the end point.

P. Srinivas, Y.L. Malathilatha, Dr.M.V.N.K. Prasad [5]- The analysis and comparison of various contour tracing and object counting methods inferred that the Moore neighborhood technique is best compared to the other methods. The paper shows that image processing is an efficient method of traffic control technique.

Pejman Niksaz [6]- This paper shows us the use of image processing in traffic management. The advantages of the method include benefits such as: 1) Non-use of sensors 2) Low cost, easy setup and relatively good accuracy and speed.

Chandrasekhar. M, Saikrishna. C, Chakradhar. B, Phaneendra Kumar. P & Sasanka. C [7]- In earlier technology more time was wasted by green light on empty roads. This problem can be solved by using image processing based intelligent controller.

Vismay Pandit, Jinesh Doshi, Dhruv Mehta, Ashay Mhatre and Abhilash Janardhan [8]- This paper shows that image processing helps in reducing the traffic congestion and avoids the wastage of time by a green light on an empty road. It is more accurate in detecting vehicle presence because of the use of actual traffic images. The system is good but improvements need to be made in order to achieve a hundred percent accuracy.

2. Methodology

Fig shows the proposed block diagram of the project which consist of- AVR Microcontroller for traffic control, MATLAB for Image Processing, GSM for messaging and Image Acquisition through camera. In this system, when the vehicle on road violates the traffic signal, its image is captured and sent to the server/database immediately. These captured images are pre-processed to extract the number plate region of the vehicle. The output image is further processed to extract the registration number using image processing algorithms. The further process includes sending an SMS to the owner of the vehicle whose contact number is linked with the registration number in the database.

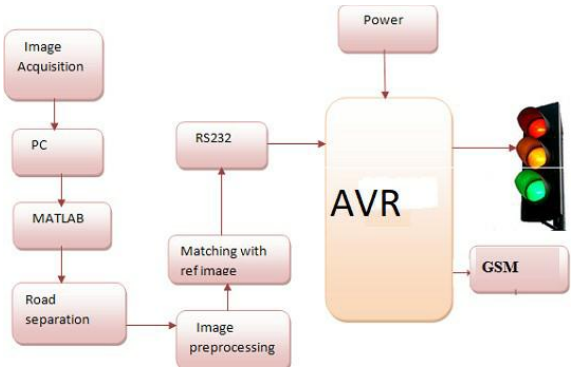

Fig -2: Block Diagram of the Project

System can be made by using MATLAB software and aim to have proper traffic management. The camera is installed in the particular area where all the lanes are visible just above the traffic light. The film comes in the form of consecutive frames and each frame is compared with the first frame from which the density of car specified, further, the number of vehicles are displayed on the screen. According to that traffic control algorithm is used to display the allocation time. Accordingly, the green light adjusted

2.1 System Overview

The various steps of our proposed system are described in Figure 2. A camera is fixed on polls or other tall structures to overlook the traffic scene as seen in [3]. Images extracted from the video are then analyzed to detect and count vehicles. Then depending on the signal-cycle (we have taken it to be 3 minutes), time is allotted to each lane. For example, if the number of vehicles in a four-lane intersection is found to be 10, 30, 20 and 20, then time allotted to each lane is in the ratio 1:3:2:2.

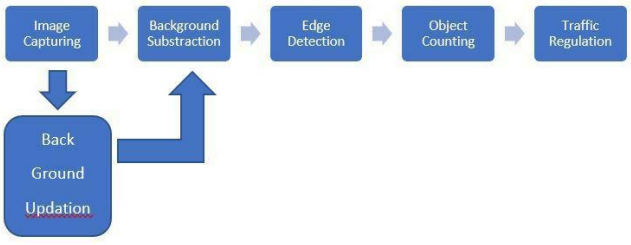

Fig -3: System Overview

2.2 Background Subtraction

Static background subtraction' has been the traditional method for real-time segmentation of an object in video-

based system. The technique is based on computing the error between a constant background frame and the current one. Video-based techniques for outdoor environments are easily influenced by factors such as weather, change in illumination and motion. Hence, a static background proves insufficient and a robust background model is necessary to deal with change of luminance. We propose the use of the adaptive background technique. Generating the current background image based on segmentation results extracted from differencing the image with the previous extracted background is the basic idea of our method.

2.3 Edge Detection

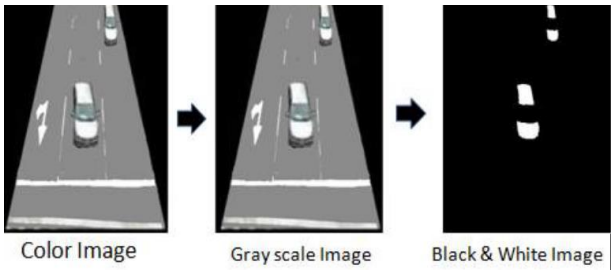

Fig -4: Processed Image

The Canny edge detector is considered to be one of the most widely used edge detection algorithms in the industry. It works by first smoothing the image and finds the image gradient to highlight regions with high spatial derivatives. It then tracks along these regions to suppress any pixel that is not at the maximum. Finally, through hysteresis, it uses two thresholds and if the magnitude is below the first threshold, it is set to zero. If the magnitude is above the high threshold, it is made an edge and if the magnitude is between the two thresholds, it is set to zero unless there is a path from this pixel to a pixel with a gradient above the second threshold. That is to say that the two thresholds are used to detect strong and weak edges, and include the weak edges in the output only if they are connected to strong edges.

2.4 Object Counting

After finding the edges the next stage is to count the number of objects as defined by the edges. There have been many algorithms suggested for object detection and contour tracing. These include the commonly used Radial Sweep method, Theo Pavlidis' Algorithm and Square Tracing Algorithm. In the Square Tracing Algorithm, against a black background, we locate a white pixel and declare it as the start pixel. This is done by starting at the bottom left corner of the grid, scanning each column of pixels from bottom to up and from left to right until a white pixel is encountered. Every time it encounters a white pixel, it turns left and moves to the next pixel. Every time it is standing on a black pixel, it turns right, tracing the edge of the contour. If no edge pixels are found near a particular pixel, then that pixel is termed to be isolated and the search for a new pixel begins. However, the square tracing algorithm is very limited in its performance and fails to extract the contour many patterns occurring in real life applications.

2.5 The Template Matching Approach

The template matching approach was then implemented. The templates used had a resolution of 42×24, hence rescaling the license plate objects prior to template matching was necessary. Character recognition was based on calculating the correlation metric, implemented using the *corr2* function, which computes the correlation coefficient between two matrices of the same size. All images from extracted objects and the template set were thus represented as 42×24 intensity matrices. The template images corresponding to the 34 possible characters A to Z and 0 to 9 excluding letters I and O were saved, and template matching was implemented by using the correlation between each extracted object from the image against all the images in the template. The correlation coefficients for each extracted object with the template set was ordered into a 34-element array, and the index of the element having the highest correlation coefficient used to identify the corresponding similarly indexed character. The characters corresponding to each extracted object were then concatenated to form a string, which is the detected vehicle registration number.

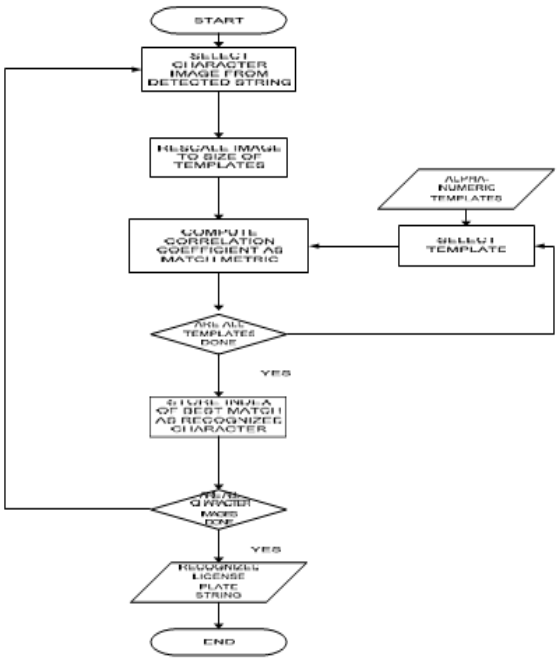

Fig -5: Flow Chart for Template matching algorithm

3. Circuit Diagram

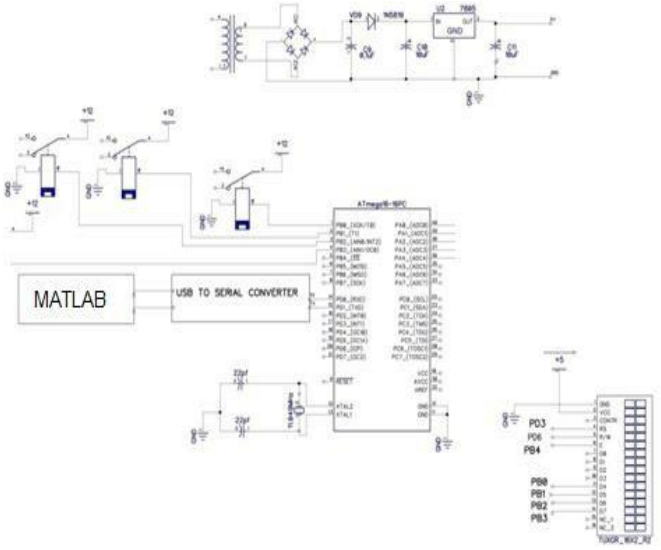

Fig -6: Circuit Diagram of the Project

The basic step in the designing of any system is to design the power supply required for that system. The steps involved in the designing of the power supply are as follows,

[1] Determine the total current that the system sinks from the supply.

[2] Determine the voltage rating required for the different components.

- The bridge rectifier and capacitor I/p filter produce an unregulated DC voltage which is applied at the I/P of 7805.
- The minimum dropout voltage is 2v for IC 7805, the voltage applied at the input terminal should be at least 7 volts.
- C1 (1000 µf / 65v) is the filter capacitor.
- C2, C4 (0.1uF ceramic), C3 (220uF/25V electrolyte capacitor) is to be connected across the regulator to improve the transient response of the regulator.
- Assuming the drop out voltage to be 2 volts, the minimum DV voltage across the capacitor C1 should be equal to 7volts (at least).

4. System Specification

4.1 AVR (AT Mega 16)

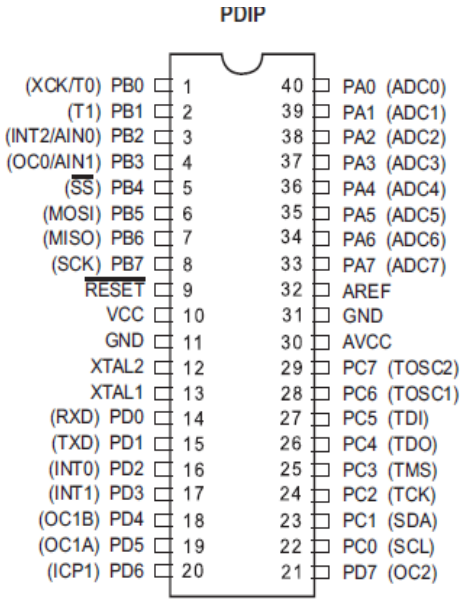

Fig -7: Pin diagram of AVR

- Power consumption: Power consumption is lower than PIC.
- UART: High baud rate are possible from low clock frequencies than PIC.
- Interrupts: in AVR vectored interrupts are more efficient than PIC.
- Instruction set/architecture: Add with carry, and compare with carry simplify multiple precision arithmetic. Good range of conditional branches.
- Clocks: Wide range of RC oscillator speed than PIC.

4.2 LCD Power Source

LCD is a Liquid Crystal Display which shows the display in 4X4 matrix. Each pin has different function as shown in Fig 8.

- LCD has 2 Power Sources
- 1. VCC and GND are at 1 and 2 NO. Pins of LCD. Used to drive the LCD 3mA current consumption.
- 2. VCC and GND is at 15 and 16 NO. pins of LCD used to drive the backlight of LCD 100 mA current
- Total current consumption = 3mA + 100mA = 103 mA
- So, in order to reduce the current requirement, we are connecting a 330-ohm resistance in series with the backlight pin VCC. This reduces the current consumption (100mA / 330ohm =0.303 mA).

  Therefore, new total current consumption = 0.303Ma

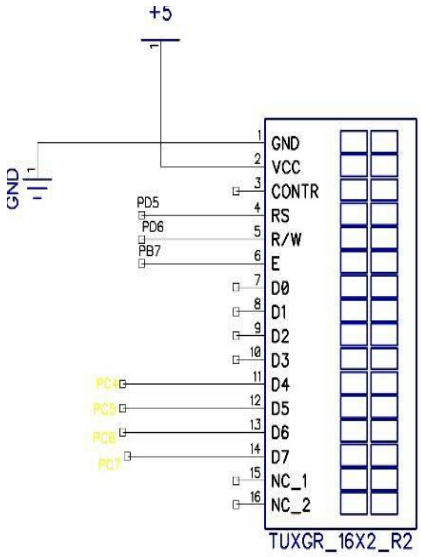

Fig -8: Pin Diagram of LCD

4.3 Power Supply

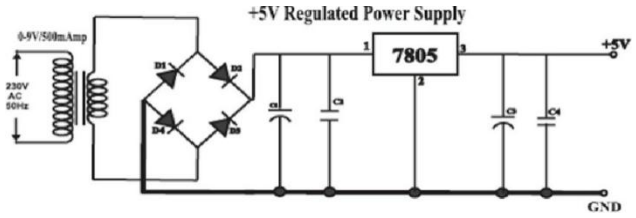

Fig -9: Circuit Diagram-Power Supply

- The basic step in the designing of any system is to design the power supply required for that system. The above Fig 9 shows the AC to DC conversion with linear output of 5V. The steps involved in the designing of the power supply are as follows,
- Determine the total current that the system sinks from the supply.
- Determine the voltage rating required for the different components.

4.4 IP Webcam App

IP Webcam turns your phone into a network camera with multiple viewing options. View your camera on any platform with VLC player or web browser. Stream video inside WIFI network without internet access. Optional Video cloud broadcasting is supported for instant global access. Two-way audio supported in tiny Cam Monitor on another android device. Use IP Webcam with third-party MJPG software, including video surveillance software, security monitors and most audio players.

5. Simulation Result

Firstly, we capture the image using onboard camera which is in RGB format i.e. colored image. Later, it is converted into Grey Scale image which is varying intensity of Black -White color. Then it is converted into Binary images which is extreme variety of Black-White image which is done using Threshold image.

Fig -10: Simulation Result

6. Application

The ANPR system designed in this paper has several applications. Some of them are mentioned below.

- Parking: The ANPR is used to automatically enter prepaid members and calculate parking fee for non-members.
- Access Control: A gate automatically opens for authorized members in a secured area
- Tolling: The car number is used to calculate the travel fee in a toll-road or used to double check the ticket.

7. Future Scope

The focus shall be to implement the controller using DSP as it can avoid heavy investment in industrial control computer while obtaining improved computational power and optimized system structure. The hardware implementation would enable the project to be used in real-time practical conditions. More information about this method can be found in. In addition, we propose a system to identify the vehicles as they pass by, thereby assisting in surveillance on a large scale.

8. Conclusion

Hence an idea was proposed to improve the existing system and make it completely automatic using Automatic Number Plate Recognition system and the GSM module. The image of the violating vehicle will be captured and processed to extract the license number plate and the contact number of the vehicle's owner. Further using GSM module, a violation SMS is sent to the owner. we discuss a method for estimating the traffic density on the different lane based on image processing, we can use it to count the number of dynamic vehicles that are passing on the highway and to control the traffic.

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