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Image Processing Based Intelligent Traffic Control System by Using Raspberry Pi

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Abstract: ***In today's generation of twenty first century, we have to face several issues a well known of that is traffic jam becoming a lot of serious day by day. The traffic congestion can also be caused by large Red light de-lays, etc. The delay of respective light is hard coded and it is not dependent on actual traffic density. Therefore for simulating and optimizing traffic control to better accommodate this increasing demand is arises. this paper is about optimization of Image processing based traffic light controller in a City using raspberry pi microcontroller . The system tries to reduce possibilities of traffic jams, caused by traffic lights, to an extent. The system is based on image processing using python. The micro-controller used in the system is Raspberry pie. Four cameras are placed on respective roads and capture images to analyse traffic density. Then according to density priorities of traffic light signals are decided. The system contains IR sensor which are mounted on the one side of road. The IR system gets activated whenever any VIP vehicle passes on road. According to this project if any ambulance comes near when the ambulance at emergency comes to any traffic post the traffic signals automatically stop the signals and give green signal for this ambulance or any other VIP vehicle.***
These techniques are in brief delineated in next section.
Keywords: Image Processing, Raspberry pi 3, python, IR sensor, traffic signals.

I. INTRODUCTION

In an old automatic traffic controlling a traffic light uses timer for every phase. Using electronic sensors is an other way in order to detect vehicles, and produce signal that to this method the time is being wasted by a green light on an empty road. Traffic congestion also occurred while using the electronic sensors for controlling the traffic. All these drawbacks are supposed to be eliminated by using image processing. We propose a system for controlling the traffic light by image processing. The vehicles are detected by the system through images instead of using electronic sensors embedded in the pavement. A camera will be placed alongside the traffic light. It will capture image sequences. Image processing is a better technique to control the state change of the traffic light. It shows that it can decrease the traffic congestion and avoids the time being wasted by a green light on an empty road. It is also more reliable in estimating vehicle presence because it uses actual traffic images. It visualizes the practicality, so it functions much better than those systems that rely on the detection of the vehicles' metal content. Image Processing is a technique to enhance raw images received from cameras/sensors placed on space probes, aircrafts and satellites or pictures taken in normal day-today life for various applications. An Image is rectangular graphical object. Image processing involves issues related to image representation, compression techniques and various complex operations, which can be carried out on the image data. The operations that come under image processing are image enhancement operations such as sharpening, blurring, brightening, edge enhancement etc. Image processing is any form of signal processing for which the input is an image, such as photographs or frames of video; the output of image processing can be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Image processing usually refers to digital image processing, but optical and analog image processing are also possible. Many techniques have been developed in Image Processing during the last four to five decades. Most of the methods are developed for enhancing images obtained from unmanned space probes, spacecrafts and military reconnaissance flights. Image Processing systems are becoming widely popular due to easy availability of powerful personnel computers, large memory devices, graphics softwares and many more. Image processing involves issues related to image representation, compression techniques and various complex operations, which can be carried out on the image data. The operations that come under image processing are image enhancement operations such as sharpening, blurring, brightening, edge enhancement .Traffic density of lanes is calculated using image processing which is done of images of lanes that are captured using digital camera. We have chosen image processing for calculation of traffic density as cameras are very much cheaper than other devises such as sensors. Making use of the above mentioned virtues of image processing we propose a technique that can be used for traffic control. The block diagram of the proposed algorithm is given on next page.

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II. METHODOLOGY

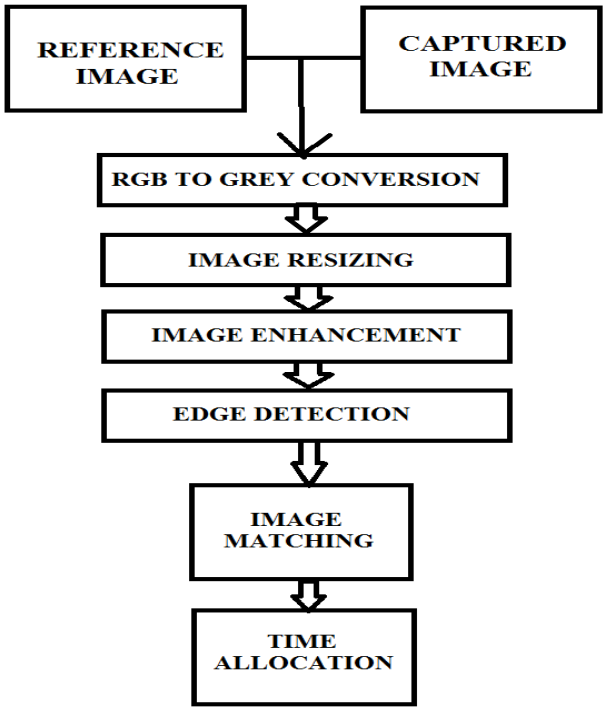

Fig: Block Diagram of Image processing based Traffic Control

A. Image Processing

The Block diagram above gives an overview of how traffic will be controlled using image processing. Various boxes in Block diagram are explained below:

1) *Image Acquisition:* Generally an image is a two-dimensional function f(x,y) (here x and y are plane coordinates).The amplitude of image at any point say f is called intensity of the image. It is also called the gray level of image at that point. We need to convert these x and y values to finite discrete values to form a digital image. Each digital image composed of a finite elements and each finite element is called a pixel.
2) *Formation of Image:* We have some conditions for forming an image f(x, y) as values of image are proportional to energy radiated by a physical source. So f(x, y) must be nonzero and finite. i.e. $0< f(x, y) < \infty$.
3) *Image Resizing/Scaling:* Image scaling occurs in all digital photos at some stage whether this be in Bayer demosaicing or in photo enlargement. It happens anytime you resize your image from one pixel grid to another. Image resizing is necessary when you need to increase or decrease the total number of pixels. Even if the same image resize is performed, the result can vary significantly depending on the algorithm.
4) *RGB to GRAY Conversion:* color images are often stored as three separate image matrices; one storing the amount of red (R) in each pixel, one the amount of green (G) and one the amount of blue (B). We call such colour images as stored in an RGB format. In gray scale images, however, we do not differentiate how much we emit of different colours, we emit the same amount in every channel. We will be able to differentiate the total amount of emitted light for each pixel
5) *Image Enhancement :* Image enhancement is the process of adjusting digital images so that the results are more suitable for display or further analysis.
6) *Edge Detection:* Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more technically, has discontinuities or noise. The points at which image brightness alters sharply are typically organized into a set of curved line segments termed edges.
7) *Image Matching:* We have used a totally different approach for image matching. Comparing a reference image with the real time image pixel by pixel..

8) %match=No. of pixels matched successfully/ total no. of pixels.

III. REQUIREMENTS

A. Hardware

1) Raspberry Pi 3
2) Webcam
3) IR sensor
4) Laptop

B. Software

1) Python
2) Open CV

C. Hardware Implimentation

1) Raspberry Pi 3:

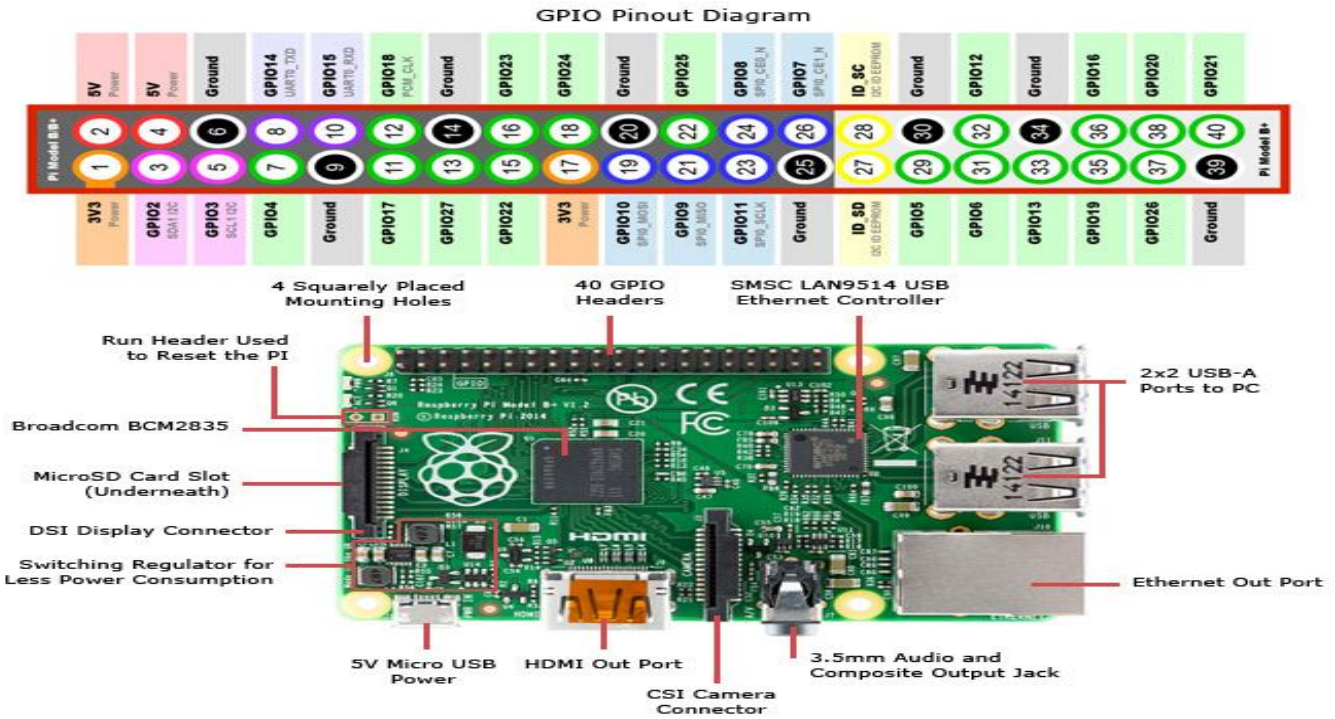

Fig.2 Pin Diagram of Raspberry Pi.

The Raspberry Pi is a credit card sized single-board computer with an open-source platform that has a thriving community of its own, similar to that of the audio. It can be used in various types of projects from beginners learning how to code to hobbyists designing home automation systems. There are a few versions of the Raspberry Pi, but the latest version, has improved upon its predecessor in terms of both form and functionality.

Features of Raspberry Pi Model 3 B:

2) *Webcam:* A webcam is a video camera that feeds or streams its image in real time to or through a computer to a computer network. When "captured" by the computer, the video stream may be saved, viewed or sent on to other networks via systems such as the internet, and emailed as an attachment. When sent to a remote location, the video stream may be saved, viewed or on sent there. Unlike an IP camera (which connects using Ethernet or Wi-Fi), a webcam is generally connected by a USB cable, or similar cable, or built into computer hardware, such as laptops.

3) *IR Sensor:* The ambulance carries an IR transmitter and IR receiver will be there some few meter before the signal. The receiver will receive the signal and the module will send the command turn on green through the RF and every traffic post will have an RF receiver. So whenever the ambulance comes near the traffic, the ambulance will transmit a code say emergency the receiver

will receive this signal .Then it immediately switch off the other signals that is it make all the signals red and later make this particular direction signal green. IR Sensors LM358 is used.

D. Software Implimentation

1) *Python:* Python is a powerful modern computer programming language. It bears some similarities to Fortran, one of the earliest programming languages, but it is much more powerful than Fortran. Python allows you to use variables without declaring them (i.e., it determines types implicitly), and it relies on indentation as a control structure. You are not forced to define classes in Python (unlike Java) but you are free to do so when convenient. Python was developed by Guido van Rossum, and it is free software. Free as in "free beer," in that you can obtain Python without spending any money. But Python is also free in other important ways, for example you are free to copy it as many times as you like, and free to study the source code, and make changes to it. There is a worldwide movement behind the idea of free software, initiated in 1983 by Richard Stallman. Like shell scripts, Python can automate tasks like batch renaming and moving large amounts of files. It can be used just like a command line with IDLE, Python's REPL (read, eval, print, loop) function. However, there are more useful things you can do with Python. For example, you can use Python to program things like:

a) Web applications
b) Desktop applications and utilities
c) Special GUIs
d) Small databases
e) 2D games

Python also has a large collection of libraries, which speeds up the development process. There are libraries for everything you can think of – game programming, rendering graphics, GUI interfaces, web frameworks, and scientific computing. Many (but not all) of the things you can do in C can be done in Python. Python is generally slower at computations than C, but its ease of use makes Python an ideal language for prototyping programs and designing applications that aren't computationally intensive.

2) *Open CV:* Open CV Stands for Open computer vision it is source library of functions. is released under a BSD license and hence it's free for both academic and commercial use. It has C++, Python and Java interfaces and supports Windows, Linux, Mac OS, iOS and Android. OpenCV was designed for computational efficiency and with a strong focus on real-time applications. Written in optimized C/C++, the library can take advantage of multi-core processing. Enabled with OpenCL, it can take advantage of the hardware acceleration of the underlying heterogeneous compute platform. Adopted all around the world, OpenCV has more than 47 thousand people of user community and estimated number of downloads exceeding 14 million. Usage ranges from interactive art, to mines inspection, stitching maps on the web or through advanced robotics.

IV. RESULT

Fig.3 Prototype of Our Project

V. CONCLUSIONS

This project presents An Image Processing Based Intelligent Traffic Control System by using Raspberry pi 3 implemented using PYTHON Programming Language. Here we also implemented a real-time emergency vehicle detection system for VIP vehicles like Ambulance, Fire brigade, Police Vans. In case an emergency VIP vehicle is detected, the lane is given priority over all the others. "Image Processing Based Intelligent Traffic control using Raspberry Pi" technique that we propose overcomes all the limitations of the earlier (in use) techniques used for controlling the traffic. Earlier in automatic traffic control use of timer had a drawback that the time is being wasted by green light on the empty. This technique avoids all this problems.

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