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Embedded based Implementation: Controlling of Real Time Traffic Light using Image Processing

G. Lloyd Singh1, M. Melbern Parthido2 , R. Sudha3
1 PG Scholar,
2 Assistant Professor,
3 Associate Professor,
PSNA College of Engineering and Technology,

ABSTRACT

We would like to bring to your attention about the problems which we face every day. Road accident is an important problem in modern world. If we observe seriously the causes of road accidents we found that narrow roads and rapid increase of means of transport are the main reasons behind increasing number of road accidents. In general, traffic rules and signs are used to control this problem; traffic light is one of the important things. Normally traffic lights are controlled manually as well as automatically. Timers for each phase are the simplest way to control the traffic light automatically. Another way is to use electronic sensors in order to detect vehicles, and produce signal. Here we suggest a system that implement image processing algorithm in real time traffic light control which will control the traffic light efficiently. A web camera is placed in each phases of traffic light that will capture the still images of the road where we want to control the traffic. Then those captured images are sequentially matched using image matching with a reference image which is an empty road image. The traffic is controlled according to percentage of matching. This system can be implemented as an embedded based module.

Keywords

Traffic light control, Embedded module, Electronic sensors, Image Processing, Image matching.

1. INTRODUCTION

Traffic problems nowadays are increasing because of the growing number of vehicles and the limited resources provided by current infrastructures. Traffic on roads may consist of pedestrians, ridden or herded animals, vehicles, streetcars and other conveyances, either singly or together, while using the public way for purposes of travel. Traffic laws are the laws which govern traffic and regulate vehicles, while rules of the road are both the laws and the informal rules that may have developed over time to facilitate the orderly and timely flow of traffic. Traffic signs or road signs are signs erected at the side of roads to provide information to road users.

1.1 Classical Traffic Control Systems

1.1.1 Manual Controlling

Manual controlling the name instance it require man power to control the traffic. Depending on the countries and states the traffic polices are allotted for a required area or city to control the traffic. The traffic polices will have things like sign board, sign light and whistle to control the traffic. They will be instructed to wear specific uniforms in order to control the traffic.

1.1.2 Automatic Controlling

Automatic traffic light is controlled by timers and electrical sensors. In traffic light each phase a constant numerical value loaded in the timer. The lights are automatically getting ON and OFF depending on the timer value changes. While using electrical sensors it will capture the availability of the vehicle and signals on each phase, depending on the signal the lights automatically switch ON and OFF.

1.2 Drawbacks

In the manual controlling system we need more man power. As we have poor strength of traffic police we cannot control traffic manually in all area of a city or town. So we need a better solution to control the traffic. On the other side, automatic traffic controlling a traffic light uses timer for each phase. Another way is to use electronic sensors 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.

1.3 Need for Image Processing in Traffic Light Control

We propose a system for controlling the traffic light by image processing. The system will detect vehicles through images instead of using electronic sensors embedded in the pavement. A camera will be installed 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 reduce the traffic congestion and avoids the time being wasted by a green light on an empty road. It is also more consistent in detecting vehicle presence because it uses actual traffic images. It visualizes the reality so it functions much better than those systems that rely on the detection of the vehicles' metal content.

2. INTRODUCTION TO IMAGE PROCESSING

Image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may 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 also are possible. This article is about general techniques that apply to all of them. The acquisition of images (producing the input image in the first place) is referred to As Imaging.

2.1 Image Acquisition

The first stage of any image processing operation is the image acquisition stage. After the image has been obtained, various methods of processing can be applied to the image to perform the many different tasks required today. However, if the image has not been acquired satisfactorily then the intended tasks may not be achievable, even with the aid of some form of image enhancement.

Digital image acquisition is the creation of digital images, typically from a physical scene. The term is often assumed to imply or include the processing, compression, storage, printing, and display of such images. The most usual method is by digital photography with a digital camera but other methods are also employed.

2.2 RGB to Gray Conversion

In photography and computing, a grayscale or grayscale digital image is an image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this sort, also known as black-and-white, are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest.

Grayscale images are distinct from one-bit bi-tonal black-and-white images, which in the context of computer imaging are images with only the two colors, black, and white (also called bilevel or binary images). Grayscale images have many shades of gray in between. Grayscale images are also called monochromatic, denoting the presence of only one (mono) color (chrome).

2.3 Image Enhancement

Image enhancement techniques in Image Processing enable you to increase the signal-to-noise ratio and accentuate image features by modifying the colors or intensities of an image. You do the following operations in image enhancement:

- Image deblurring
- Device-independent color management
- Image transform
- Image conversion

2.4 Edge Detection

Edge detection is a fundamental tool in image processing and computer vision, particularly in the areas of feature detection and feature extraction, which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The same problem of finding discontinuities in 1D signal is known as step detection. The purpose of detecting sharp changes in image brightness is to capture important events and changes in properties of the world. It can be shown that under rather general assumptions for an image formation model, discontinuities in image brightness are likely to correspond to,

- Discontinuities in depth,
- Discontinuities in surface orientation,
- Changes in material properties and
- Variations in scene illumination.

In the ideal case, the result of applying an edge detector to an image may lead to a set of connected curves that indicate the boundaries of objects, the boundaries of surface markings as well as curves that correspond to discontinuities in surface orientation. Thus, applying an edge detection algorithm to an image may significantly reduce the amount of data to be processed and may therefore filter out information that may be regarded as less relevant, while preserving the important structural properties of an image. If the edge detection step is successful, the subsequent task of interpreting the information contents in the original image may therefore be substantially simplified.

However, it is not always possible to obtain such ideal edges from real life images of moderate complexity. Edges extracted from non-trivial images are often hampered by fragmentation, meaning that the edge curves are not connected, missing edge segments as well as false edges not corresponding to interesting phenomena in the image – thus complicating the subsequent task of interpreting the image data.

2.4.1 Edge detection techniques

To detect the edges of an image several operators are being used in

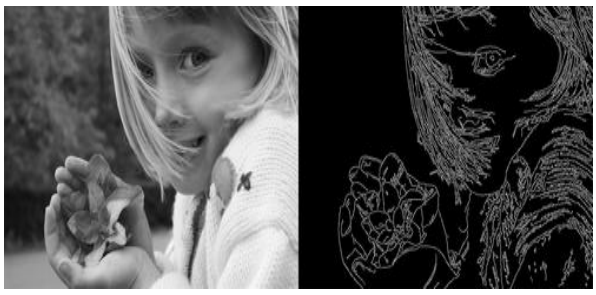

Figure 1: Edge detected Image MATLAB.

Some important operators are explained below,

2.4.1.1 sobel operator

The operator consists of a pair of 3×3 convolution kernels as shown in Figure 1. One kernel is simply the other rotated by 90°.

2.4.1.2 robert's cross operator

The Roberts Cross operator performs a simple, quick to compute, 2-D spatial gradient measurement on an image. Pixel values at each point in the output represent the estimated absolute magnitude of the spatial gradient of the input image at that point. The operator consists of a pair of 2×2 convolution kernels as shown in Figure 1.8.3 one

kernel is simply the other rotated by 90°. This is very similar to the Sobel operator.

2.4.1.3 prewitt's operator

Prewitt operator is similar to the Sobel operator and is used for detecting vertical and horizontal edges in images.

2.5 Image Matching

Edge based matching is the process in which two representatives of the same objects are paired together. Any edge or its representation on one image is compared and evaluated against all the edges on the other image. Edge detection of reference and the real time images has been done using Prewitt operator. Then these edge detected images are matched and accordingly the traffic light durations can be set.

3. IMPLEMENTATION

As mentioned earlier the components required for this system are classified by two different modules and mentioned. They are explained below.

- Hardware and interfacing
- Software module

The software module has been completed with the reference and captured images. Remaining the hardware module and interfacing the software module with hardware module has to be done in future. MATLAB version 7.8 as image processing software comprising of specialized modules that perform specific tasks has been used.

3.1 Methodology

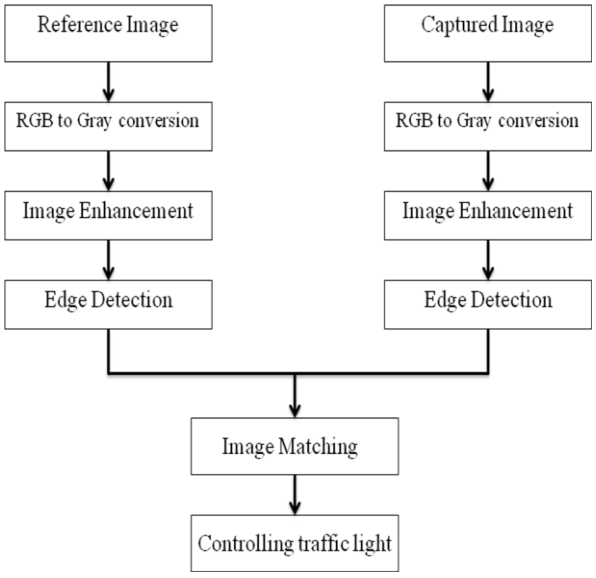

Figure 2: Methodology

3.2 Calculation of Matching and Timing Allocation

After edge detection procedure both reference and real time images are matched nd traffic lights can be controlled based on percentage of matching.

- If the matching is between 0 to 10% - green light is on for 90 seconds.
- If the matching is between 10 to 50% - green light is on for 60 seconds.
- If the matching is between 50 to 70% - green light is on for 30 seconds.
- If the matching is between 70 to 90% - green light is on for 20 seconds.
- If the matching is between 90 to 100% - red light is on for 60 seconds.

4. EXPERIMENTAL RESULTS

Figure 3: Reference Image

Figure 4: Captured Image 1

Figure 5: Captured Image 2

Figure 6: Captured Image 3

5. CONCLUSION

Past researches have showed a promising result for including image processing in traffic light control. Earlier in automatic traffic control use of timer had a drawback that the time is being wasted by green light on the empty road. This problem is avoided by this method. Also it deals with the images so it will produce better visual results than electrical sensors in automatic traffic light control. Overall, the system is good but it still needs improvement to achieve a hundred percent accuracy. In future this method can be achieved to give hundred present efficient results by the upcoming latest technologies.

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