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Real Time Toll Rate Determination Using Image Processing & Network Database

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Abstract

A toll road, also known as a turnpike or toll way, is a public or private roadway for which a fee (or toll) is assessed for way. It is a form of road pricing typically implemented to help convalesce the cost of road structure and protection, which (on public roads) amounts to a form of taxation. Toll roads in some form have survive since antiquity, collecting their fees from passing travelers on foot, wagon or horseback; but their significance increased with the rise of the automobile, and modern toll ways collect their fees from motor vehicles completely. The amount of the toll usually varies by vehicle type, weight, or number of axles, with shipment trucks often stimulating higher rates than cars. It is composed at toll-collection points known as toll booths, houses, plazas, stations, bars or gates. Some toll-collection points are unmanned and the user deposit money in a pot which measures the amount and allows passage or entry if enough. To cut cost and minimize time delay many tolls today are composed with some form of automatic or electronic toll group utilizing electronic communication from a toll payer's transponder and the toll collection system. The paper presents a new way for electronic toll collection system and to match car number plate finding system. The electronic toll collection system (ETS) has been made-up based on microcontroller. Here a system is developed to collect tolls according to the weight of the vehicle. The car number plate detection method utilizes template matching method to estimate the location of car number plate. Then, using this output from the template identical method, color information is used to eliminate the unnecessary color areas from the estimated number plate region without disturbing the correct color regions. Hence, the number plate region can be resolute more precisely. This work can easily be done by image processing system using MATLAB. The method has low difficulty and reduced the processing time magnificently. This automated system also shows a better appearance in highway traffic management. This paper shows the gateway to fabricate a highly mechanical toll-plaza.

Keywords: *Toll road, Electronic toll collection system (ETS), vehicles*.

I. TOLL COLLECTION TECHNOLOGY OVERVIEW

The suitable combination of technology and operational measures is needed to meet the functional supplies of the emerging tolling program in Washington State. In addition, the combination also must provide a path for rearrangement from a single facility to multiple facilities, and be able to evolve along with changes in machinery. Toll collection, in all of its forms, consists of the subsequent five primary mechanisms:

A. Situation the Toll Rate

The toll rate must be resolute, and the fees clearly convey to the user. Customarily, tolls are fixed amounts based upon vehicle independence such as number of axles. Tolls can be assessed at a point on a road, or based upon the distance traveled. Advances in traffic situation monitoring now allow toll rates to vary based on the level of overcrowding.

B. Collecting the Toll

Toll collection can engage a direct cash transfer at a toll booth or a transfer of data via electronic technology, with real money altering hands through other means. Either way, it is necessary to ensure the correct toll is collected, and that user and collector deception is dispirited.

C. Enforcement beside Violations

Even though most users want to be honest, some will try to avoid payment. Like any business, toll collection business enterprise must identify, quantify, and mitigate these latent losses. The main goal of enforcement is to ensure that there is an acceptable level of compliance, and enforcement efforts are fair and dependable.

D. Management and secretarial

Finally, toll collection, audit, accounting, preservation, security, customer service, and enforcement must be managed, with a full secretarial of all revenue and costs linked with the process.

E. Interoperability

As customers use dissimilar toll facilities in the State, they have an anticipation that electronic toll collection instrument will be fully sociable at all toll facilities. The remainder of this section provides an overview of the basics of toll compilation technology.

II. MANUAL TOLL COLLECTION

Until rather recently, the most common move toward for collecting tolls was to have the driver stop and pay a toll collector sitting in a tollbooth. The toll collector determines the quantity to be paid by each vehicle based upon its independence or categorization.

III. ELECTRONIC TOLL COLLECTION (ETC)

Regular Vehicle Identification (AVI) technology can accurately identify a precise vehicle at highway speeds, thus, enabling a wide diversity of ETC applications. In its basic form, a vehicle passing during a toll collection point has its appreciation device read, after which the toll is deducted from the customer's preexisting account or the customer is sent an invoice. The driver pays the toll without stopping and tollbooths are not necessary. ETC also determines whether the cars passing are enrolled in the program, and gathers in progression on the vehicle for further compilation or enforcement action.

A. Vehicle Classes and metaphors

There are four classes of vehicle familiar for tolling when using the Go between Bridges.

B. Motorbike/motorcycle

Two wheeled motor vehicles whether or not a sidecar is distant to it.

C. Car

Car means a motor vehicle (even if towing a trailer or caravan), counting a taxi, other than a motorcycle or a profitable vehicle.

D. Light commercial vehicle

Light profitable vehicle means a motor vehicle that:

1. Is a two axle inflexible truck or load carrying van or utility, having a gross vehicle mass better than 1.5 tones but not more than 4.5 tones, or
2. Have spatial proportions which are significantly consistent with the axle and mass criteria as described in point 1.

IV. THE IMAGE PROCESSING SYSTEM FOR WHEEL RECOGNITION

At the start, the system will be used as a tool to authenticate the fare charged. The setup cost is a major plan criterion to be measured and therefore, instrument of the system is low-cost products. The basic setup includes a low-end digital video camera and a computer. The announcement of the image produced by the camera is only 320x240 pixels. Since it is hard to examine axles of a vehicle and consequently, the system will detect wheels instead of axles. The camera is located so that wheels of a vehicle can be captured when it passes during the toll booth. Figure 1 shows the point of the camera relative to the road and a sample image captured by the camera is given in Figure 2. From explanation, it takes about two seconds for the front wheel and the rear wheel of a car to pass during the camera, implying that the dispensation system must complete the gratitude process within the two-second time frame.

Due to the location of the camera, the image of the wheel is slightly indistinct; however, it still resembles to a circle. Similar to [1], we practical Hough transform for circle [2] in order to detect the survival of the wheel. The major benefit of Hough transform is its capability of identifying a wheel even when it is only partially appearing in an image.

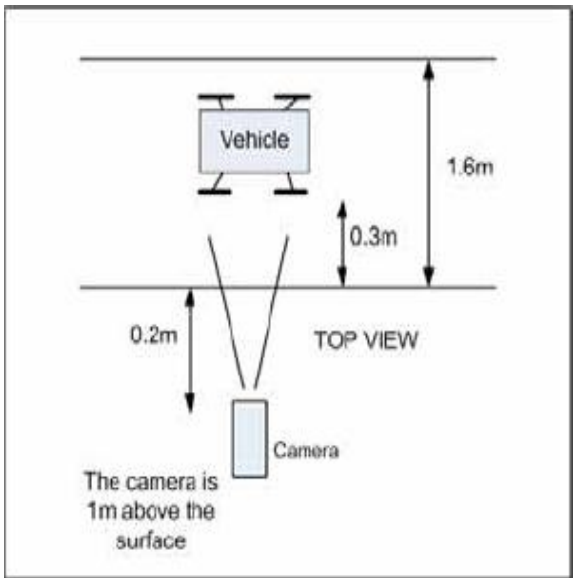

Figure 1 Camera set up for the wheel detection system

A. Hough Transform for circles

Hough transform (HT) for detecting circles is based on the same standard introduced by the Hough transform [3] for line segments. The Hough transform is a well known method for detecting parametric curves (such as circles) in images. The basic operations of Hough transform are to map characteristic point in the image space to the limit space, or the Hough space, where the parameters are used to clarify the curve to be detected.

In order to perform an inclusive Hough transform, we should judge all possible values for the radius. though, in our application, we are penetrating for wheels of a vehicle; hence we can border our search space by important a suitable range for the radius of the wheel.

Figure 2 Sample image incarcerate by the system

B. Image Processing

Hough transform is based on characteristic points extracted from the unique image and usually, edges are used as the characteristic points. Result of applying Sobel filter to one of the captured image is shown in Figure 3.

Though, other areas in the image, as shown in Figure 3, also create a important number of edge points, which are unpaid to the surface of the road.

If we relate the Sobel filter to an image when there is no survival of a vehicle, the result, depicted in Figure 4, is a huge number of edge points shaped. The edge points come from the touch of the road can be regarded as noise, which will hearten a huge slide in the implementation time of the Hough transform and most prominently will produce dimension errors so technique(s) to reduce the needless edge points is sought.

In this paper, we described an regular system to count the number of axle of a vehicle in real-time for toll compilation purposes. The Hough transform for circle is used for detecting the survival of a wheel. Our experiments show that the Hough transform is appropriate for such an application. At present, we can procedure up to 24 images within 1.5s and it satisfies the timing restriction imposed upon the system. Our system setup is easy and by using commodity mechanism, its setup cost is also low.

Operation code of the system is the same in Europe (Fig. 3). As a car approaches a toll plaza, the radio-frequency (RF) field emitted from the antenna activates the transponder. The transponder broadcasts a signal back to the lane antenna with numerous basic in order. That in series is transferred from the lane antenna to the central database.

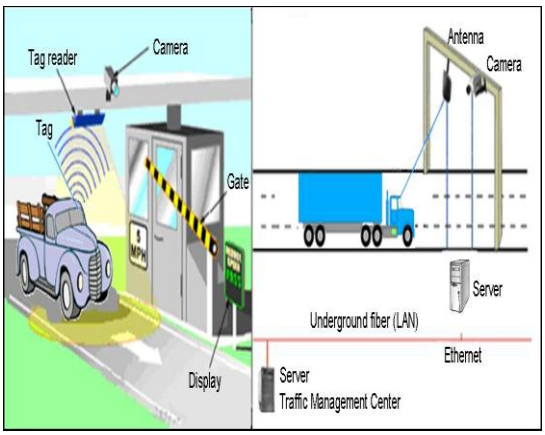

Figure 3: E-ZPass System (on the left – blocked road line, on the right – open road line)

Algorithm

```
clc;
Lock all;
Obvious all;
h = wait bar(0,'Real Time Toll Rate willpower Using Vision allowance V1.1..... Loading.....');
    For i=1:2450,
    Wait bar (i/100)
    End
    Lock (h)
    Disp ('Video Initialization');
    Vid=video input ('winvideo','1');
    Appetizer (vid);
    Reply = input ('System Initialized Press any key continue.....''s');
    Reply=0;
    s = input ('Acquiring conditions Parameters Press L for Low, M For Medium, H For High','s');
    Disp;
            if(s == 'L')
      Disp ('Low Rainfall Parameter');
      conditions_param=1;
     End
     If(s == 'M')
       Disp ('Medium Rainfall Parameter');
      conditions_param=1.5;
     End
    If(s == 'H')
      Disp ('High Rainfall Parameter');
      conditions_param=2;
    End
    Flag=0;
    While (flag == 0)
      If(s=='S')
     Reply = input ('Press any key to take snapshot.....''s');
      Img=get snapshot (vid);
      Figure;
      Imshow (img);
      Gimg=rgb2gray (img);
      Figure;
      Imshow (gimg);
      Eimg=edge (gimg,'canny');
      Figure;
      Imshow (eimg);
     [Centers, radii, metric] = imfindcircles (eimg,[10 40]);
     Figure;
    Imshow (img);
    Viscircles(centers, radii,'EdgeColor','b');
    Disp ('Radii')
    Disp (radii);
    End
     s = input ('Press S to Snapshot & E to Exit','s');
      If(s == 'E')
```

```
        Flag=1;
    End
End
Close preview (vid);
Delete (vid);
```

V. RESULTS

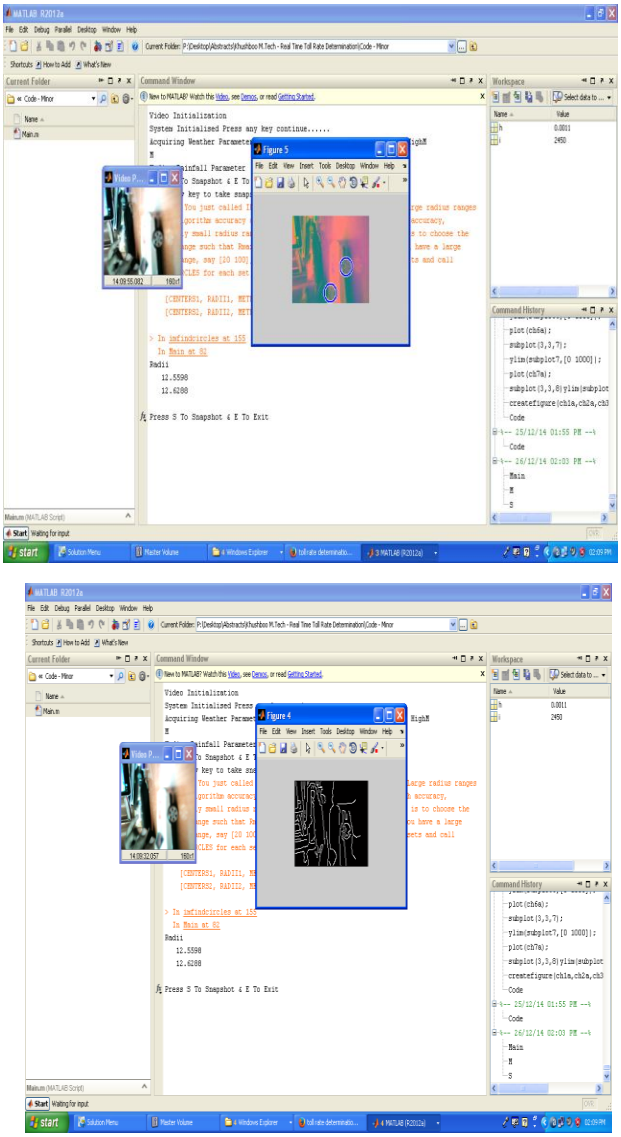

Figure 4: Results

VI. CONCLUSION

The paper presents a new technique for electronic toll compilation system and to match car number plate discovery system. The electronic toll collection system (ETS) has been untrue based on microcontroller. Here a system is residential to collect tolls according to the weight of the vehicle. The car number plate detection method utilizes template corresponding method to estimated the location of car number plate. Then, using this output from the template corresponding method, color in order is used to remove the surplus color areas from the probable number plate region without moving the correct color regions. Hence, the number plate region can be resolute more precisely. This work can easily be done by image processing system using MATLAB.

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