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SPEED BREAKER DETECTION USING BLOB ANALYSIS

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Abstract - One of the major problems in developing countries is the road maintenance, most of the accidents happen due to unmarked speed breaker in the national highway which leads to a threat to drivers. An Intelligent transportation system plays a vital role in the advanced driver assistance system. The speed breaker recognition is used for vehicle and human safety. Earlier speed breaker detection method involves sensors, accelerometer and GPS. In this paper, a novel method for speed breaker detection and recognition is developed to alert the driver before the vehicle hit the speed breaker. In BLOB analysis, image processing techniques are used to detect the speed breaker in the given image. Camera fixed in the vehicle is used to capture the image of the road and it is analysed in the real time to detect the presence of speed breaker. This technique can be used for the painted speed breaker.

Keywords: Image processing, blob analysis, Speed breaker

I.INTRODUCTION

Vehicle over speed is one of the major factors for road accidents. To control speed in sensitive areas speed breakers are used across the road. Thus speed breakers are mainly used to reduce the vehicle speed and improve the pedestrian's safety. However, in case of driver not noticing the speed breaker well in advance leads to injuries, vehicle damage and casualties. Due to the high vehicle speed, the presence of speed breakers on the national highways is a major problem. Many unauthorized speed breakers are laid on the road which does not follow the standard size proposed by National Highway Authorities. Generally, the speed breakers are of width 9 meters with the height ranging from 6 to 30cms [1]. Apart from speed breakers, potholes, mud pits, and garbage are some of the common problems on the road which creates hindrance for the traffic. Different speed levels are set based on aspects of types of roads and speed breakers. Due to the vehicle movement, the detection must be quick to warn the drivers before hitting the speed breaker. A survey report records that in India totally 1, 42,485 people were died due to road accidents. According to Road Transport and Highway Ministry of India, because of accident 4746 injuries occurred due to speed humps, 6672 people died due to potholes and speed breakers [8].It is necessary to have a driver support system with speed breaker detection in the vehicle to inform the driver about the approaching speed breakers well in advance. Reducing road accidents is possible by proper monitoring of road anomalies like speed bump and potholes.

Various methods are proposed in the literature for the detection of speed breakers using dedicated hardware such as 3-axis accelerometer, GPS. Road condition detection with the help of smart phones and image processing techniques are also proposed. Fernandez and W. Zhang [1,2] proposed forward looking LIDARs and cameras to detect the speed breakers on the road. LIDAR based road and road edge detection algorithms were developed to identify the region of interest. Hull [3], in his works proposed a Distributed Mobile sensing system named "CarTel" for various applications including Traffic monitoring, Speed breaker detection etc. For speed breaker detection, this system has centralized software to collect, process, deliver, and visualize data from vibration sensors located on vehicle. All the details about the road conditions will be maintained in a centralized location. The data from the centralized location will be accessed by the applications using continuous queries, which are executed using a Delay-tolerant continuous query processor. A similar system called "Pothole Patrol" was proposed by Jakob Eriksson [4] for road surface monitoring. The condition of the road is gathered using Vibration sensors and GPS. Machine learning algorithms are used to process the gathered data and to detect the anomalies on the road.

Detection of road conditions using smart phones [5-14] is gaining interest in the recent past due to the increase in the number of smart phone users. Mohan [6], in his work discussed Nericell, a system

that monitors road conditions and detect the speed breakers using accelerometer, microphone, GSM Radio and GPS sensors that are available in smartphones. However, in smartphone based method, the orientation of the phone with the direction of motion is very important. Thus, before accelerometer measurement is done, it is vital to virtually reorient the accelerometer with respect to the vehicle. Heuristics based method is used in Nericell for road condition monitoring. The main drawback of Nericell system was addressed by Ravi Bhoraskar [7], in his proposed system "Wolverine" In this system magnetometer was used to find the horizontal orientation of the phone instead of visual reorientation. In Wolverine method K-means clustering and Support Vector Machine (SVM) was used for determining the traffic and road conditions.Accelerometers in the android-based mobile phones [8, 9] are used to collect the information about the road which is then analysed to understand the condition of the road.This information are stored in a server and helps in educating the drivers about the road conditions. Vamsee has proposed a real-time solution [10] using android service that runs in the background and relies on Google Maps application in the smartphone. This service will give an early warning to the driver in case of a speed breaker or a bumpy road. Although a lot of effort has been put to develop a system using smart phones, there are certain limitations which includes vibration pattern of sensor data, GPS Error, Network overload, Delay and Battery draining problem. These limitations make it difficult to use smartphones for real time road condition detection.

BUMPSTER, a mobile cloud computing system for speed breaker detection was proposed by ArhumSavera [15]. In this work data from different places are collected and stored in cloud and support vector machines are used to warn the driver ahead of the approaching speed breakers. Driver assistance system using Image processing algorithms [16-18] were proposed in the literature. In [16, 17], speed breaker detection using edge detection and morphological image processing were discussed. AjitDanti [18], in his work proposes automatic driver assistance system. In this work, Hough Transformation is employed for Lane detection, Color Segmentation and Shape Modelling with Thin Spline Transformation (TPS) is used with nearest neighbour classifier for road sign detection and Classification. Further, K-means clustering based algorithm is used for pothole detection.

In this work, BLOB analysis is used for the speed breaker detection. The proposed method aims to warn the driver about the approaching speed breaker by using blob analysis. Overview of the proposed method is discussed in chapter 2. The performance analysis of the method is given in chapter 3 and the conclusion is given in chapter 4.

II.PROPOSED METHODOLOGY

In our proposed system, a camera is mounted in front of the vehicle focusing on the road surface. Real time images captured by the camera are processed to identify the presence of the speed breaker.The flowchart of the proposed methodology is shown in figure 1. The method consists of three steps and the detailed explanation of each step is given.

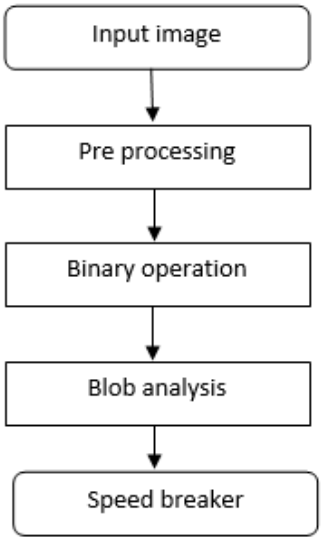


Fig.1.Flowchart of the proposed method

2.1 Pre Processing

In the pre-processing stage, the image is resized to a same size of 206 × 198 pixels. Because edge of the speed breaker to be detected correctly at this size of the image. As processing of colour image is complex and also luminance is the important parameter in distinguishing the visual feature, the RGB colour image is converted to gray scale image [17]. The luminance value of the gray scale image is given by

$$L(x,y) = 0.21R(x,y) + 0.72G(x,y) + 0.07B(x,y) \quad \ldots\ldots\ldots (1)$$

Where, R-Red element of the image

G-Green element of the image

B-Blue element of the image

x,y-Position of a pixel

After gray scale conversion, canny edge detection algorithm is used to detect the edges of the image. Images at different stages of pre-processing are given Figure 2.

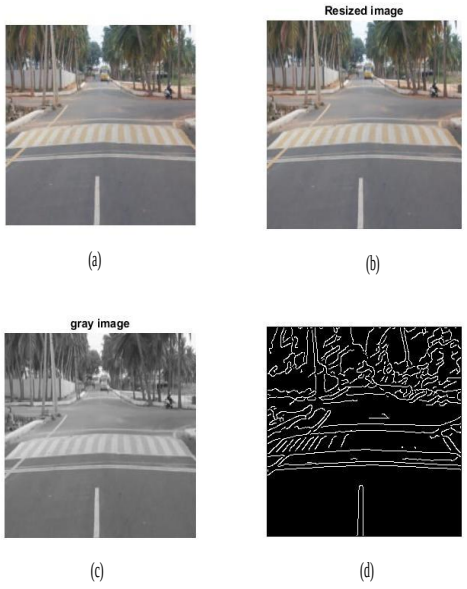


Fig.2. Different stages of pre- processing (a): Input Image (b): Resized Image (c): Gray Scale Image (d): Image after Edge Detection

2.2 Binary Operation

The Image after edge detection is converted to binary image. This conversion is implemented by thresholding. Thresholding value has to be selected very carefully as low threshold value will produce an image with all the edges and high threshold value may result in removal of the wanted edges. In this work, threshold value is fixed by using trial and error. The Connected component approach is used to remove the noise in the binary image. Morphological opening operation is applied on the binary image so that the smaller regions having number of pixels less that 200 will be removed. The structure element for the morphological operation is selected as a square structure with size 10. Any connected component having size less than 10 will be removed by opening operation. Opening operation is performed by Erosion followed by Dilation as given in equation 2.

$$A^{o} B=(A\Theta B) \oplus B \ldots\ldots (2)$$

A-Input binary image
B-Structureelement
^{o} -Morphological Opening
Θ–Morphological Erosion
⊕- Morphological Dilation
Figure3.gives the image after morphological opening operation.

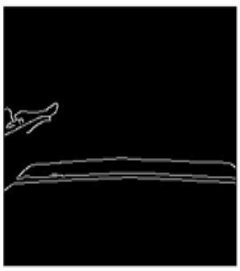


Fig.3. Resultant image after Morphological opening operation

2.3 Blob Detection Technique

Blob is defined as the region of a connected pixel in the image which is used to identify the particular region of the image. Blob detection provides the two categories, Foreground and Background. Performance of the blob analysis depends on the succeed segmentation of the image. It separates the good blob image from the background. Remaining pixel of the image will be eliminated.Area of blob consists of number of pixel in the blob which is used to remove the small or large region from the image. Bounding box of the blob represents the minimum rectangle which is contain the four pixel value namely minimum- x value, maximum- x value, minimum- y value and maximum- y value. Width and height of the rectangle to be represent the as the xmax, xmin and ymax, ymin respectively. By using this values to create the bounding box as the ROI. Bounding box (xbb,ybb) calculated by using this expression (1) and (2)

$$x_{bb} = x_{min} + \frac{x_{max} - x_{min}}{2} = x_{min} + \frac{x_{max}}{2} - \frac{x_{min}}{2} = \frac{x_{max} + x_{min}}{2} \ldots\ldots (3)$$

$$y_{bb} = y_{min} + \frac{y_{max} - y_{min}}{2} = y_{min} + \frac{y_{max}}{2} - \frac{y_{min}}{2} = \frac{y_{min} + y_{max}}{2} \ldots\ldots (4)$$

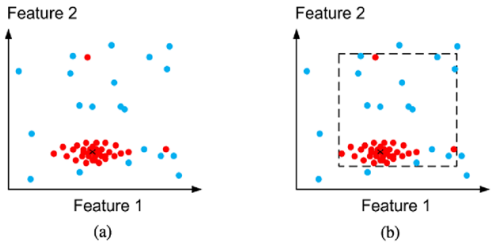


Fig.4. Boundary box formation

Figure 4. Shows the two features that span a 2-dimensional feature space whereeach feature has an allowed range.If BLOB appears inside an image that has feature values, then these two ranges together form a rectangle.This approach is known as a box classifier and the area of the rectangle is known as the decision region. The image with the decision box is shown in Figure 5.



Fig. 5.Output Image

III. PERFORMANCE ANALYSIS

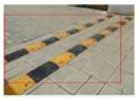
The speed breaker detection is complicated task. Lot of problems arise due to the variation of construction in terms of their shapes, color, length, width, height. Most of the speed breaker can be detected by using colorirrespective of the height and width. In this paper, the performance of detection algorithm is measured using two parameters namely true positive and true negative. True positive is the measure of detecting the speed breaker from an image and true negative is a measure of not predicting the speed breaker in an image when it is present. To check the performance of the algorithm, we have categorized the total set of images into five categories. Categories 1-4 consists of colored speed breakers where each category has different color and pattern. Category 5 consists of speed breakers without any color. In each category number of images are taken and the performance of the algorithm is analysed. The percentage of true positive and true negative for all the categories are tabulated in Table.1.

Table 1. Performance of the BLOB analysis for different category speed breaker

Category	*Name*	*No of Samples*	*Correctly predicted*	*Incorrectly predicted*	*True positive %*	*True negative%*
1	White-Yellow	300	280	20	93	6
2	Yellow-Black	200	165	35	82	17
3	White	200	160	40	80	20
4	White Black	150	100	50	66	33
5	No paint	150	30	120	20	80

In category 1 and category 2 speed breaker are detected positively for more than 80% of the time. The performance of the proposed BLOB analysis is poor for category 4 and 5. As it is difficult to identify category 5 speed breakers visually, the BLOB analysis also gives very poor performance for this. This method is suitable only for painted speed breakers. Table 2 shows the sample image of each category with corresponding output image.

Table 2. Various category of speed breaker and its output

Category	Input image	Output image
1		
2		
3		
4		
5		

IV. CONCLUSION AND FUTURE SCOPE

Early warning of speed breakers to the drivers is vital for safe driving and also a key facility that need to be implemented in autonomous vehicles. The proposed BLOB analysis for speed breaker detection uses simple image processing techniques and can be implemented in real time. Images captured using a single camera is analyses for finding the speed breakers. This method works fine for colored speed breakers whereas the performance is not up to the mark for uncoloured speed breakers. Images taken from more than one camera can be used to improve the accuracy. Classification algorithm can also be used for better detection of speed breakers.

REFERENCE

[1].C. Fernández *et al.*, "Free space and speed humps detection using lidar and vision for urban autonomous navigation," *IEEE Intell. Veh. Symp. Proc.*, pp. 698–703, 2012.

[2].W. Zhang, "LIDAR-based road and road-edge detection," IEEE Intell. Veh. Symp. Proc., pp. 845–848, 2010.

[3].B. Hull *et al.*, "CarTel : A Distributed Mobile Sensor Computing System," *4th ACM Conf. Embed. Networked Sens. Syst.*, pp. 125–138, 2006.

[4].J. Eriksson, L. Girod, B. Hull, R. Newton, S. Madden, and H. Balakrishnan, "The pothole patrol: using a mobile sensor network for road surface monitoring," *Proceeding 6th Int. Conf. Mob. Syst. Appl. Serv. - MobiSys '08*, p. 29, 2008.

[5].G. Chugh, D. Bansal, and S. Sofat, "Road Condition Detection Using Smartphone Sensors: A Survey," *Int. J. Electron. Electr. Eng.*, vol. 7, no. 6, pp. 595–602, 2014.

[6].P. Mohan, V. N. Padmanabhan, and R. Ramjee, "Nericell: Rich Monitoring of Road and Traffic Conditions using Mobile Smartphones," *Proc. 6th ACM Conf. Embed. Netw. Sens. Syst. - SenSys '08*, p. 323, 2008.

[7].R. Bhoraskar, N. Vankadhara, B. Raman, and P. Kulkarni, "Wolverine: Traffic and road condition estimation using smartphone sensors," *2012 4th Int. Conf. Commun. Syst. Networks, COMSNETS 2012*, 2012.

[8].P. V. P. Tonde, A. Jadhav, S. Shinde, A. Dhoka, and S. Bablade, "Road Quality and Ghats Complexity analysis using Android sensors," *Ijarcce*, vol. 4, no. 3, pp. 101–104, 2015.

[9].S. Pargaonkar, D. Jawalkar, R. Chate, S. Sangle, M. D. Umale, and S. S. Awate, "Safe Driving Using Android Based Device," *Int. J. Eng. Trends Technol.*, vol. 18, pp. 151–154, 2014.

[10]. K. K. M. Vamsee, K. Vimalkumar, R. E. Vinodhini, and R. Archanaa, "An early detection-warning system to identify speed breakers and bumpy roads using sensors in smartphones," *Int. J. Electr. Comput. Eng.*, vol. 7, no. 3, pp. 1377–1384, 2017.

[11]. K. Yagi, "Extensional Smartphone Probe for Road Bump Detection," *17th ITS World Congr.*, no. 1, pp. 1–10, 2010.

[12]. R. K. Goregaonkar, "Assistance to Driver and Monitoring the Accidents on Road by using Three Axis Accelerometer and GPS System," *Int. J. Electron. Commun. Comput. Eng.*, vol. 5, no. 4, pp. 260–264, 2014.

[13]. M. Fazeen, B. Gozick, R. Dantu, M. Bhukhiya, and M. C. González, "Safe driving using mobile phones," *Intell. Transp. Syst.*

IEEE Trans., vol. 13, no. 3, pp. 1462–1468, 2012.

[14]. D. V. M. Prof. Trupti Dange, "Analysis of Road Smoothness Based On Smartphones," *Int. J. Innov. Res. Comput. Commun. Eng.*, vol. 3, no. 6, pp. 5201–5206, 2015.

[15]. M. Jain, A. Singh, S. Bali, and S. Kaul, "Speed-Breaker Early Warning System," *Proc. 6th USENIX/ACM Work. Networked Syst. Dev. Reg.*, 2012.

[16]. A. L. J.Martin, C.Cruz, "Speed booms detection for a ground vehicle with computer vision," *12th WSEAS Int. Conf. Math. Comput. methods Sci. Eng.*, pp. 258–264, 2010.

[17]. W. Devapriya, C. N. K. Babu, and T. Srihari, "Advance Driver Assistance System (ADAS) - Speed bump detection," *2015 IEEE Int. Conf. Comput. Intell. Comput. Res. ICCIC 2015*, 2016.

[18]. A. Danti, J. Y. Kulkarni, and P. S. Hiremath, "An Image Processing Approach to Detect Lanes, Pot Holes and Recognize Road Signs in Indian Roads," *Int. J. Model. Optim.*, vol. 2, no. 6, pp. 658–662, 2012.