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Real time Pothole and Speed Breaker Detection Using Image Processing Techniques

Munukoti Likhit[1]

Dept. of Computer Engineering Army Institute of Technology, Maharashtra, India

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Abstract - *Because ageing roads are not being maintained and inadequate traffic signs are not being used to prevent accidents, the number of road accidents has dramatically increased. Additionally, it is more beneficial to choose an alternative route after learning in advance about the state of the road. This study explores how image processing can be used to process the photos and notify the driver of an automobile in advance of such threatening scenarios. In order to obtain an image that contains detection of all these points and instructs the driver of an automobile, we will utilize Image Processing techniques, Image Data Cleaning Methods, Speed Breaker Detection techniques, and Potholes Detection Algorithms. Additionally, we'll be concentrating on how we may improve and increase the dependability of this application's correctness and efficiency.*

Key Words*: *Pothole Detection, speed bump detection, Convex Hull, Image Processing, Real time video Processing

1. INTRODUCTION

India, the most populous country in the world and has a quickly developing economy. Developing an automated driver guidance system is very important in the context of Indian road conditions. Speed-breaker detection, potholes detection and Sudden Edge Detection are essential because many accidents happen due to the sudden intrusion of a speed-breaker and potholes.

Evidently, poor streets and the unforeseen occurrence of potholes serve as the primary causes of street accidents. Additionally, it causes the wheels to rapidly degrade and potentially ruins the car. This technology warns the driver in advance when a speed limiter or end edge of the road is there and will trigger the system to start reducing the vehicle's speed right away. speed limiters Potholes are constructed in places where controlling speed becomes critical to prevent accidents, such as accident-prone areas, abrupt curves, crowded residential streets, and unattended level crossings. The physical characteristics of the speed bumps and potholes, such as their height, length, and the length of any ramps, vary.

There are typically two types of speed breakers: the marking kind and the unmarking or non-marking type. The earlier speed breaker can be more easily identified using image processing techniques than the later one. Even so, without a yellow or white striped warning, it might be exceedingly difficult to spot an unmarked speed breaker. When driving, the human visual system can detect long-distance speed bumps with markings, but it has a difficult time detecting unmarked speed bumps. Therefore, a novel approach to finding the real-time speed breaker is suggested. For the driver to avoid accidents or discomfort while driving, the detection of this kind of speed breaker is crucial.

As one type of pavement distresses, potholes are important clues that indicate the structural defects of the asphalt road, and accurately detecting these potholes is an important task in determining the proper strategies of asphalt-surfaced pavement maintenance and rehabilitation. However, manually detecting and evaluating methods are expensive and time consuming. Thus, several efforts have been made for developing a technology that can automatically detect and recognize potholes, which may contribute to the improvement in survey efficiency and pavement

1.1 Potholes Detection

According to previous research Potholes are uneven surface found on roads and highways, which are made by constant vehicular traffic and weather conditions.

Pothole detection algorithms in image processing play a crucial role in ensuring road safety and infrastructure maintenance. These algorithms utilize various computer vision techniques to identify and locate potholes or road surface defects in images or video footage. A common approach involves color and texture analysis, where algorithms are trained to recognize distinct color and texture characteristics of potholes compared to the surrounding road surface. Potholes typically appear darker and have a different texture due to their depth and damage, making them distinguishable through this method.

Edge detection is another widely used technique in pothole detection algorithms. These Algorithms are employed to identify abrupt changes in pixel intensity that correspond to the edges of potholes. These detected edges can serve as a basis for further analysis and pothole identification.

Pothole identification has showed considerable potential when using ML approaches, particularly CNNs. Additionally, segmentation techniques are used, enabling the computer to distinguish between the road surface and probable potholes.

After the road has been divided into segments, further research can be done on the segments to precisely detect and pinpoint potholes. In the template matching method, several elements of the road image are matched to a template image of a pothole. A match reveals the presence of a pothole when it is discovered. Even though template matching can be computationally demanding, it can be useful in certain circumstances. Overall, image processing algorithms for detecting potholes are a crucial tool for maintaining and enhancing the safety of roads, using a variety of methods to precisely identify and pinpoint these risks.

Table -1: Pothole detection Algorithms performances

Algorithm	**Accuracy**
Local Neighbors	70%
Canny Edges	75%
CNN with multiple layers	90.5%
CNN and stereo vision	97.2%

The Convex Hull algorithm serves as a fundamental concept in computational geometry. This algorithm is employed to find the smallest convex polygon that encompasses a given set of points within a plane. The Convex Hull's primary purpose is to simplify complex point sets into a more manageable convex shape, making it useful in various applications, including computational geometry, computer graphics, image processing, and geographic information systems.

The modelling of discovered potholes or other road flaws is made simpler by Convex Hull algorithms, which find use in pothole identification. Convex Hull plays a crucial role in post-processing and fine-tuning the data gained from other detection methods, even if it isn't often employed to directly detect potholes.

The Convex Hull algorithm can be used on possible pothole regions after they have been discovered using methods like edge detection, color analysis, or machine learning. The main objective is to build a convex polygon that contains the discovered pothole. This polygon aids in outlining the pothole's contour or outer perimeter, thus defining its shape.

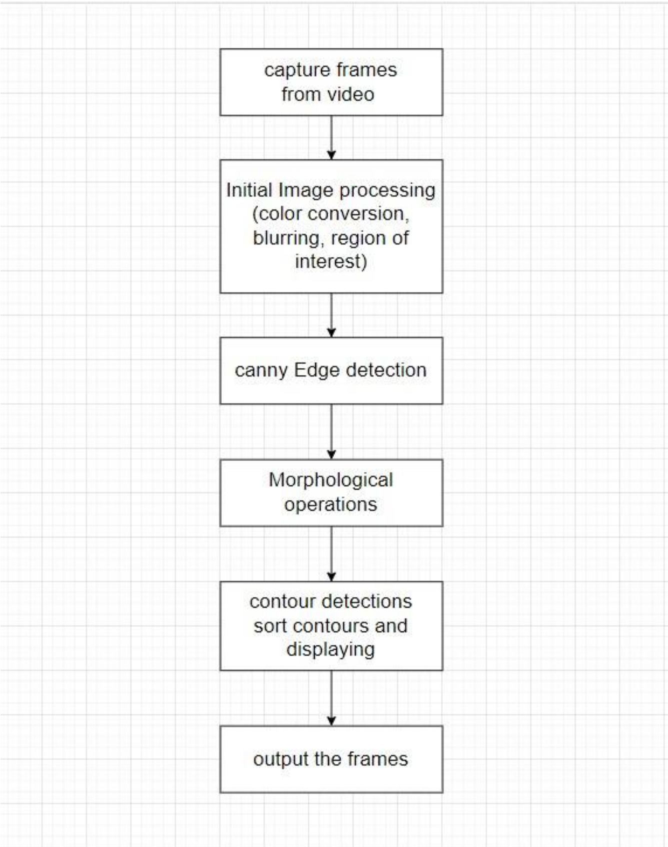

Fig -1: Flow chart of Potholes detection

1.2 Speed Bump detection

The development of speed bump detection algorithms in image processing is essential for improving driver awareness and road safety. These algorithms are intended to locate speed bumps or other road abnormalities using photos taken by cameras mounted on moving cars or by systems for roadside monitoring. To accomplish accurate and effective detection, these algorithms make use of a variety of strategies and techniques.

Edge detection is a typical method used in speed bump detection systems. The sharp fluctuations in pixel intensity that frequently correlate to the edges of speed bumps are easier to discern with the use of edge detection algorithms like the Canny edge detector, Sobel operator, or Scharr filter.

After edges are found, more analysis can be done to find probable speed bump areas. A key method that is commonly used in image processing speed bump detection techniques is canny edge detection. The technique can quickly recognize rapid changes in pixel intensities inside an image, precisely outlining the edges of speed bumps, by applying the Canny edge detector. This edge information is a crucial place to start when looking for probable speed bump areas in the image. The Canny edge detector is a useful tool for improving the accuracy of speed bump detection since it can filter out noise and produce well-defined edges, making sure that only pertinent features are taken into account in following processing steps. As a result, Canny edge detection plays a pivotal role in improving road safety by enabling the reliable identification of speed bumps on the road, contributing to the overall efficiency of automated driving systems and advanced driver assistance features.

Feature extraction is a crucial component of speed bump detection algorithms. In order to distinguish speed bumps from other objects or road surfaces, picture regions can be used to extract features including texture, color, and shape properties. For example, texture analysis can help distinguish between a speed bump's rough surface and the smoother road.

Speed bump detection is also increasingly using machine learning and deep learning approaches. Convolutional Neural Networks (CNNs) excel at this task because they can recognize and understand the intricate patterns and forms connected to speed bumps. On labeled datasets, which are made up of photos with annotated speed bump locations, these algorithms are trained. The network can detect speed bumps in real-time photographs as it gains knowledge from this inputs.

Table -2: Speed bump detection Algorithm performances

Algorithm	**Accuracy**
Local Neighbors	56%
Canny Edges	65%
CNN with multiple layers	88.71%
CNN and stereo vision	97.44%

To improve the robustness of speed bump detection, many algorithms also incorporate post-processing steps. These steps involve filtering out false positives and refining the detected speed bump regions. Techniques like morphological operations and clustering can be applied to achieve this.

In recent developments, some speed bump detection algorithms leverage the power of 3D vision. Stereo cameras or LiDAR (Light Detection and Ranging) sensors are used to create 3D point clouds of the road surface. This three-dimensional information can provide a more accurate representation of the road, aiding in speed bump detection and height estimation.

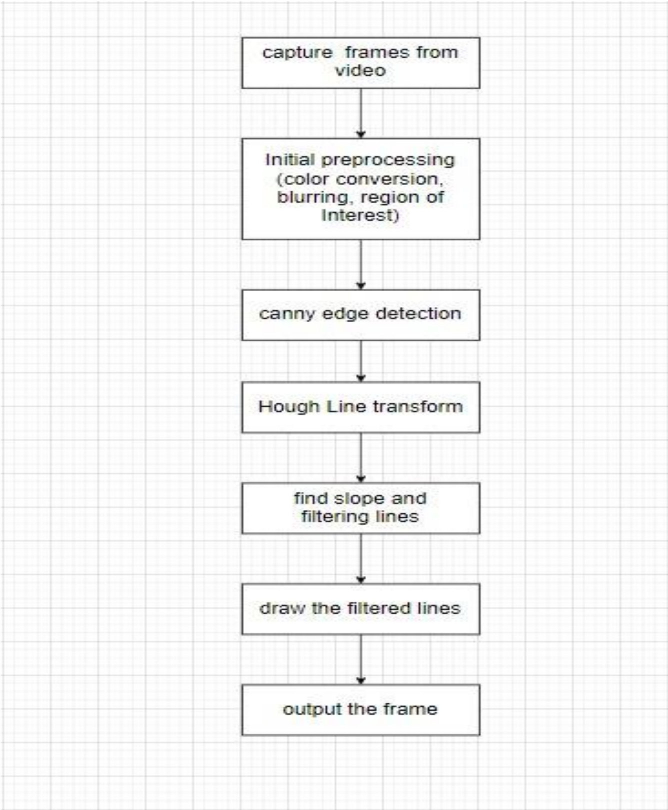

Fig -2: Flow chart of Speed Bump detection

2. METHODOLGY

The system we are striving for is one that can be created by deductive analysis. even though identical tools are readily available. Due of anomalies and a lack of a set pattern, none are used on Indian roadways. We adopted this strategy to make sure that we utilize the earlier cutting-edge techniques and create a lot more sophisticated model. It is appropriate for this issue because road safety is a fairly broad area of study and there are constantly new developments. We can employ predefined algorithms and improve them to achieve our goals rather than having to start from scratch.

The use of self-driving automobiles will significantly impact energy efficiency, perimeter security, and traffic accident reduction. Computer vision is a branch of computer science that examines how computers might be employed to extract more in-depth information or comprehension from digital images or movies. From a larger viewpoint, it is simply the automation of activities that a human visual system can carry out on a daily basis. Deep learning belongs to a group of machine learning techniques. As opposed to task-specific models, it is founded on the idea of learning data representatively. supervised, semi-supervised, or unsupervised learning methods are all possible. Computer vision includes image processing, therefore this option is taken into account. Here, one should perform a number of tasks. Real-time lane detection is the basic function of these models. Lane detection enabled on image processing techniques is one of the main methods in lane detection at current situation, and there are many kinds of detection algorithms coming regularly.

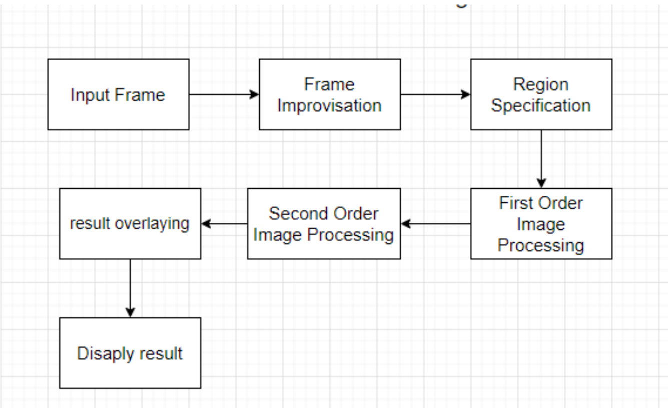

Fig -2: Flow Chart of Algorithm

Data for our study was collected using a mobile device on college grounds. The roads are more in keeping with the style of traditional Indian roadways, and movies and pictures of them have been taken. The information gathered includes every instance of the darkened, shallowed, and bumpy roadways we regularly experience. These are employed instead of alternatives because the issue is with our roads, not with any other form of transportation. The group analyses the data, and numerous recommendations are welcomed before the processing actually begins. Numerous inputs were gathered throughout the processing, and these helped the team advance. Manu ethical issues are taken into consideration during this process as we are dealing with a very sensible issue, which are lives in this case.

3. CONCLUSIONS

The main reasons for accidents are speed limiters and potholes. To prevent accidents, automatic recognition of speed limit signs and potholes is crucial. One of the most difficult and crucial parts of SAD is finding unmarked speed bumps and potholes. Additionally, it is essential to assess the effectiveness of different Speed Breakers and Potholes detection approaches, and researchers have created a number of measures to gauge the algorithms' accuracy and robustness. However, there is still a lot of work to be done to enhance the performance of detection techniques, particularly when processing complicated and noisy photos as well as for real-time pothole and speed breaker identification. Overall, the continued development of detection techniques will enable more advanced computer vision applications, such as object recognition, image segmentation, and tracking, and contribute to advances in fields such as medicine, security, and autonomous vehicles.

REFERENCES

[1] S Neinaber, MJ Booysen, RS Kroon, "Detecting potholes using Simple Image processing Techniques and real world Footage" Stellenbosch University, Private Bag X1, Matieland

[2] Mae M. Garcillanosa, Jian Mikee L. Pacheco, Rowie E. Reyes, Junelle Joy P. San Juan "Smart Detection and Reporting of Potholes via Image-Processing using Raspberry-Pi Microcontroller" Cabuyao City, Philippines

[3] Jin Lin and Yayu Liu Ajit Danti, Jyoti Y. Kulkarni, and P. S.Hiremath, "An Image Processing Approach to Detect Lanes, Potholes and recognize road Signs in Indian Roads",International Journal of Modeling and Optimization, Vol. 2, No.6, December 2012.

[4] Vijayalakshmi B, Kiran P, Kishor Jadav B "Detection of Potholes using Machine Learning and Image Processing", International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 NCAIT - 2020 Conference Proceedings

[5] Nelson Kennedy et al, "Speed-bump Detection using Otsu's Algorithm and Morphological Operation", International Journal of Emerging Technologies 11(3), pp. 989-994, 2020

[6] Martins Irhebhude, Oladimeji Adeyemi, Adeola Kolawole, "Speed Breakers, Road Marking Detection and Recognition Using Image Processing Techniques", European Journal of Applied Science, 7(5), 30-42, 2019.

[7] M. Afrin, M. R. Mahmud, and M. A. C. Fernández et al., "Free space and speed humps detection using lidar and vision for urban autonomous navigation," in proceedings IEEE Inteligent Vehicle Symposium, 3-7 June 2012, pp. 698–703.

[8] Varmaa V. S. K. P et al, "Real Time Detection of Speed Hump/Bump and Distance Estimation with Deep Learning using GPU and ZED Stereo Camera", 8th International Conference on Advances in Computing and Communication (ICACC), 2018.