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Image Based Pothole Detection System through Machine Learning

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Abstract: *Potholes can cause damage such as punctures and wheel damage, dents and vehicle floor damage, vehicle collisions and serious accidents. Therefore, accurate and fast hole detection is one of the important tasks to determine the good strategic in the ITS (Intelligent Transportation System) service and in the route management system. Several efforts have been made for developing a technology which can automatically detect and recognize potholes, Since the image related to road damage includes objects such as holes, cracks, shadows and tracks, there is the problem that it is difficult to detect a specific object. In this paper, we propose a pothole classification model using edge detection in the road image. The proposed method converts RGB (red green and blue) image data, including holes and other objects, to grayscale to reduce the amount of computation. It detects all objects with the exception of holes using an object detection algorithm. The ultrasonic sensor detects holes and alerts the user.*

Keywords: Potholes, Detection, Sharpening Filter, RGB Extraction, UV Sensor, Arduino, GSM, etc.

I. INTRODUCTION

India, the second most famous country in the world and a booming economy. Highways are the dominant means of transport in India. No matter where you are in India, driving is a breathtaking and multi-thought endeavor that includes, in theory, a lifelong endeavor. Over the past two decades, the number of vehicles has increased dramatically.

They emerge when the top layer of the road, the asphalt, has been worn away by truck traffic and has exposed the concrete base. Once a hole has formed, it can be several centimeters deep, with rainwater accelerating the process, becoming a major cause of road accidents. Potholes are not only the number one cause of road accidents; they can also be fatal for motorcycles. Road pits are particularly dangerous for drivers when driving at high speeds. Why, the driver can hardly see the potholes in the road surface. Also, if the car goes through potholes at high speed, the impact could break the car's tires. The proposed system will output the three-dimensional information of the holes and determine the distance between the hole and the car to inform the driver in advance. Currently, the primary pothole detection methods still rely on public reporting through hotlines or websites, such as the Ohio Hole Reporting website. However, this report generally lacks accurate information about the size and location of the holes. Moreover, this information is also usually out of date. A method for detecting potholes in the roadway has been reported in real-time 3DScanning system for pavement deformation inspection using high-speed 3D cross-scan techniques. However, the high-speed 3D transverse scanning equipment is too expensive and proposed a cost-effective solution to identify holes on the roads, and also to measure the depth and height of each hole using ultrasonic sensors. All hole information is stored in the database (cloud). Then alerts are delivered as flash messages with a beep through the Android app. In order to correctly detect the depth of the hole, the ultrasonic sensor must be fixed under the car, which means that the car must pass the hole first.2D vision-based solutions can also detect potholes. The regions corresponding to the holes are represented in a matrix of square tiles and the estimated shape of the hole is determined. However, the 2D vision-based solution can only work under uniform lighting conditions and cannot get the exact depth of the holes. To overcome the limitations of the above approaches, we propose a detection method based on stereoscopic computer vision, which provides three-dimensional measurements. Therefore, the geometric characteristics of the holes can be easily determined based on computer vision techniques. The proposed method requires two cameras to take pictures at the same time. Compared to expensive high-speed 3D cross-scan equipment, USB cameras are affordable and flexible. The geometric information of the holes can be obtained from the stereo camera.

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II. LITERATURE REVIEW

H. K. I. S. Lakmal and Maheshi B. Dissanayake proposed the paper titled "Pothole Detection with Image Segmentation for Advanced Driver Assisted Systems". In this article, potholes are the main reason why rainwater gets trapped on roads. In general, it is advisable to avoid these puddles while driving. This research presents an advanced vision-based driver assistance system that detects puddles on paved roads. The paper analyzes the contribution of edge features, texture features and filtered Gabor features to water surface detection. First, these characteristics are classified according to their importance.

Redressal, Aditi Kandoi and Harsh Agarwal and Bhalchandra N Chaudhari proposed the title "Pothole Detection using Accelerometer and Computer Vision with Automated Complaint" In this paper, in particular, they are a major cause of road accidents worldwide and must be dealt with immediately by the authorities. This article presents a solution that uses mobile civilian sensors, as well as image-based alternatives to detect potholes in real time, using machine learning. The solution also includes rotating existing complaints, assigning location tags and prioritization. Additionally, the solution provides a prediction of the probability of hole problems by constantly updating location time series data.

Gayathri Lakshmi and V. Udaya Sankar proposed the title "Image based Road distress detection". In this article, roads are very important for the movement of people and goods. Good road infrastructure reduces travel time and cost. Poor road infrastructure can cause an increase in travel time, more consumption of fuel and lead to accidents due to difficulty in driving. All these factors will have a cascading effect on the economy as the prices of essential commodities are directly related to the easy of transportation. Hence, it is necessary to detect the distresses on roads like potholes and do regular repairs. Initially, manual inspection was done by the concerned employers, who go check the roads and take note of the areas where there is a requirement of repair. With the development in technology, the focus on implementing a smart method of inspection increased. To build an accurate and quick detection system, an Earth Mover's Distance (EMD) based model is proposed in this paper.

Yasuhiro Kawasaki and Kousuke Matsushima proposed the title "Image-based pavement crack detection by percolation theory". In this paper, there is a lot of road damage such as cracks, potholes and ruts on some sidewalks. If they remain in an uncomfortable state, traffic accidents such as road accidents and motorcycle falls will occur. In the present study, we present the approach of a percolation theory based on the detection of very precise cracks. The shadow reduction approach is used to detect cracks more accurately. Experimental results show that many types of cracks can be detected correctly and quickly with the adaptive search window method.

III. PROPOSED METHOD

In order to improve the accuracy of feature extraction, eight different preprocessing algorithms were used. The algorithms used were converting to grey scale image, sharpening filter, median filter, smooth filter, binary mask, RGB (Red Green Blue) extraction, and histogram. RGB values from images are extracted before converting them to a grayscale image. The sharpen filter is applied to the grayscale image to sharpen the details of the infected region. Advanced feature will be added such as Entropy, Skewness etc. We using CNN algorithm to detect holes. Ultrasonic sensor detects holes and alerts user.

3.1 Image Processing

Image preprocessing is a subset of the electronic domain where in the image is converted to an array of small integers, called pixels, which represent a physical quantity such as the brightness of the scene, stored in a digital memory and processed by a computer or other digital device.

A grayscale image is simply an image in which the only colors are shades of gray. The reason for differentiating these images from any other type of color image is that less information needs to be provided for each pixel. In the figure each pixel represents a value from 0 to 255 verifying the grey level. These operations can be extended to color images too. A normal grayscale image has a color depth of 8 bits = 256 levels of Gray. A "true color" image has 24-bit color depth = 8 x 8 x 8 bits = 256 x 256 x 256 colors = ~16 million colors.

Image softening is the improvement of digital image quality while ignoring the provision of degradation. Graphics programs are often accustomed sharpen and blur pictures in numerous ways, admire distinction masking or deconvolution. Another type of image enhancement involves some form of contrast. Noise reduction only estimates the

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state of the scene without the noise and is not a substitute for getting a "cleaner" image. Object recognition includes the method of determinative the object' and recognition starts with the sensing of knowledge with the assistance of sensors, such as thermal sensors, then decoding these data in order to acknowledge Associate in Nursing object or objects. Image editors have provisions to form a picture bar chart of the image being edited. The histogram plots the number of pixels within the image with a specific brightness worth.

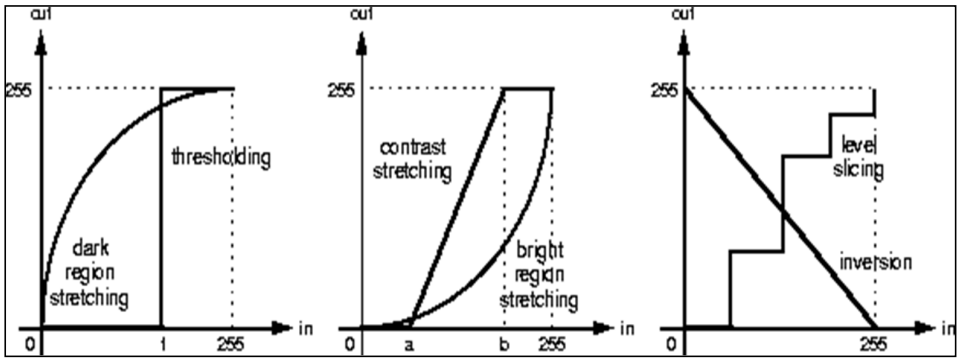

Figure 1: The Grey Value Histogram

3.2 Image Segmentation

Image segmentation is generally used to locate objects and boundaries (lines, curves, etc.) in images. Image segmentation is the process of partitioning a digital image into meaningful, disjoint regions. Modeling is a process of feature extraction and object and pattern recognition from a given image. Significant regions can represent objects in a three-dimensional scene image, regions corresponding to industrial regions. Three of the most commonly used techniques for digital image segmentation are the, Gray-level thresholding technique, when using this technique for segmentation of the image, all pixels whose gray levels are equal to or greater than a certain threshold are assigned to the object. The rest of the pixels are assigned to the background of the object.

Gradient-based segmentation technique, they are the boundary tracking technique, the gradient image thresholding, and Laplacian edge detection.

Boundary tracking technique, this technique starts with scanning the image for the pixel with the highest gradient. This pixel is for sure on the object's boundary. Then a 3 x 3-pixel segment (with the original pixel in the center) is used as a trace search for the next pixel with the highest gradient, close to the original one.

Gradient Image Threshold, limits the image to a low level to identify the object and the background, which are separated by bands of border dots. Then we gradually increase the threshold level, making both the object and the background grow. When they finally touch, without merging, the points of contact define the boundary.

Laplacian boundary detection, the Laplacian is a second-order scalar derivative operator which, for a two-dimensional function f(x,y) Regional growth technique, the image is divided into several small regions. Then the properties of the pixels in each region are computed. In the next step, the average properties of adjacent regions are examined.

3.3 Classification

A convolutional neural network (CNN) may be a style of artificial neural network utilized in image recognition and process specifically designed to method constituent data.

One of the main parts of neural networks are convolutional neural networks (CNN). CNNs use image recognition and classification to detect objects, recognize faces, etc. They are made up of neurons with learnable weights and biases. A Convolutional neural network (CNN) is a neural network that has one or more convolutional layers and are mainly used for image processing, classification, segmentation and other self-related data.

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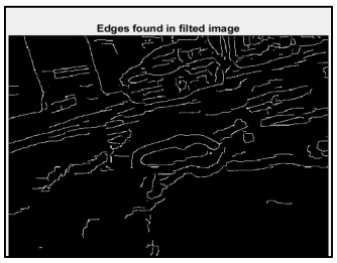
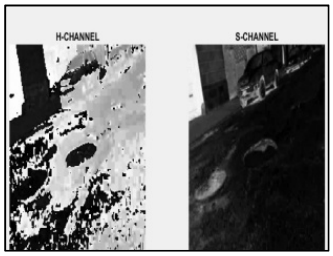
A. Original

B. Gaussian Flitter

C. RGB to Gray Scale

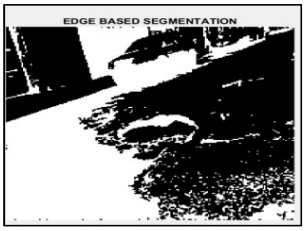


D. Edges Found in Filled Image

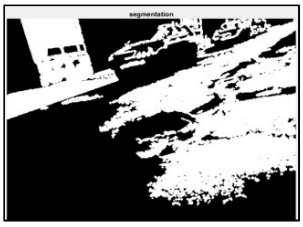


E. S and H Channel

F. Enhancement

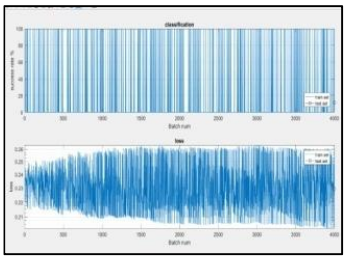


G. Edge-Based Segmentation



H. Segmentation

I. Iteration



J. Classification

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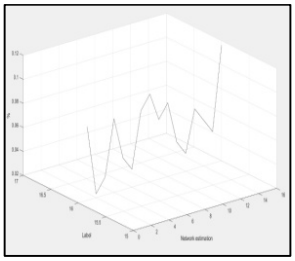
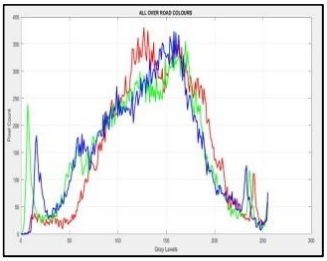


K. Graph



L. All Over Road Image

Figure 2: Result Images at Each Step using the Proposed Method

IV. METHODOLOGY

4.1 ARDUINO (ATMega328) MICROCONTROLLER

There are 20 digital input/output pins on this board. A USB connector, a power jack, an ICSP header, and a reset button are among the features. ATmega328 microcontroller, 5 V operating voltage, 7-12 V input voltage (recommended). 6-20 V input voltage (limits), 14 digital I/O pins (of which 6 provide PWM output) 6 analogue input Pin. Arduino is a programming language that allows you to create computers that can sense and control more of the physical environment than your typical desktop computer. It's an open-source physical computing platform that includes a development environment for building software for the board and a simple microcontroller board.

Arduino can be used to create interactive devices that accept inputs from various switches or sensors and operate lights, motors, and other physical outputs. Arduino initiatives may be self-contained or talk with software program set up in your computer. The Arduino programming language is primarily based totally at the Processing multimedia programming surroundings and is an implementation of Wiring, a comparable bodily computing platform. The Arduino is a system that connects all of our sensors.

Figure 3: ARDUINO (ATMega328) MICROCONTROLLER

4.2. GSM MODEM

A GSM (Global System for Mobile Communication) Modem is a wi-fi modem that works with a GSM wi-fi Network. A wi-fi modem behaves like a dial-up modem. The most important distinction among them is that a dial-up modem sends and gets statistics via a hard and fast Telephone line even as modem sends and gets statistics via radio waves. A GSM modem may be an outside tool or a PC card / PCMCIA card. Typically, an outside GSM Modem is hooked up to a pc via a serial cable or USB cable. A GSM modem within side the shape or a PC Card / PCMCIA Card is designed to be used with a computer pc.

Both GSM modem and dial-up modems help a not unusual place set of widespread AT instructions. You can use a GSM modem as a dial-up Modem. In addition to the same old AT instructions, GSM modems help a prolonged set of AT instructions. These prolonged AT instructions are described withinside the GSM standards. With the following:

- Reading, writing and deleting SMS messages
- Sending SMS messages
- Sign strength monitoring
- Monitoring the charging fame and charger degree of the battery
- Reading, writing and looking telecall smartphone book entries.

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The quantity of SMS messages that may be procedures via way of means of a GSM modem in keeping with minute may be very low-best approximately six to 10 SMS messages in keeping with minute.

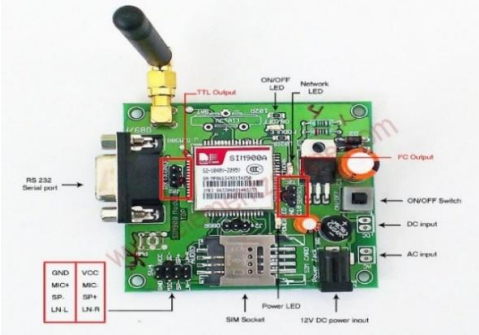

Figure 4: GSM Modem

4.3 ULTRASONIC SENSOR

An unhearable sensing element could be a device that uses undulations to work out the space to associate degree item. It determines distance by emitting a sound wave at a nominative frequency and listening for it to replicate back. It is very important to keep in mind that ultrasonic sensors may not detect certain objects. Unhearable sensors are devices that find distance between the sensor and therefore the target item by changing power into energy within the style of ultrasonic waves.

Figure 5: Ultrasonic Sensor

Inaudible waves are longitudinal mechanical waves that travel through a medium as a series of compressions and rarefactions in the direction of propagation. Ultrasound refers to any undulation that exceeds the human aural vary of 20,000Hz. It senses the space between the vehicle and therefore the pothole. Within the correct position the unhearable sensing element is placed on the vehicle to find the holes. This sensor provides the distance data to the PIC microcontroller.

4.4. LCD BOARD

The LCD (Liquid Crystal Display) is a kind of show that makes use of the liquid crystals for its operation. Here, we are able to take delivery of the serial enter from the pc and add the cartoon to the Arduino. The characters could be displayed at the LCD. The LCDs have a parallel interface, which means that the microcontroller has to govern numerous interface pins right away to manipulate the show. The interface includes the subsequent pins: A sign up select (RS) pin that controls wherein withinside the LCD's reminiscence you are writing records to. hello paintings with the aid of using the use of liquid crystals to supply an image. The liquid crystals are embedded into the show screen, and there may be a few shapes of backlight used to light up them. The real liquid crystal show is fabricated from numerous layers, inclusive of a polarized clear out and electrodes.

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Figure 6: LCD Display

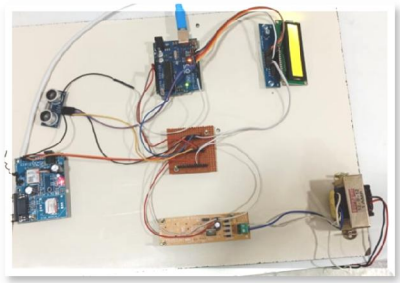

Figure 7: Arduino Connected with all Other Devices

V. RESULTS

5.1 OUTPUT FOR POTHOLE DETECTION

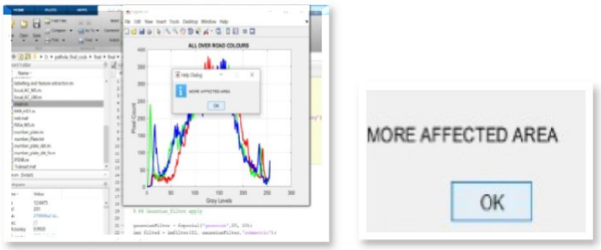

Figure 8: Display the Output for Pothole Detection

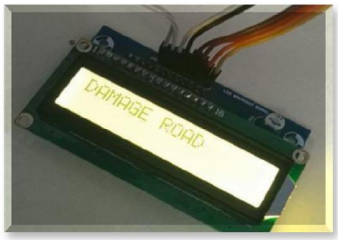

Figure 9: Display the Output for Damaged Road

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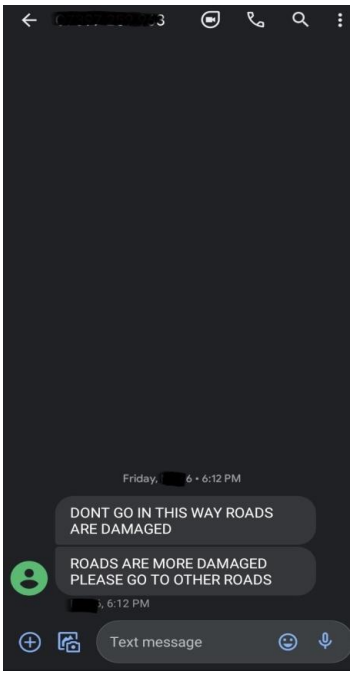

Figure 10: Notify to the user while Driving in Affected Road

5.2 OUTPUT FOR NO POTHOLE DETECTION

Figure 11: Display the output for No Pothole Detection

5.3 OUTPUT FOR AVERAGE POTHOLE DETECTION

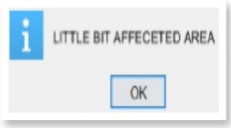

Figure 11: Display the output for Average Pothole Detection

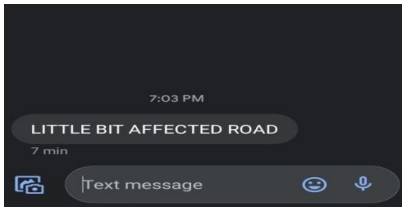

Figure 12: Notify to the user while in the little bit affected road

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VI. CONCLUSION

Using our method, unbroken road areas are higher distinguishable within the reworked and might be simply extracted exploitation Otsu's thresholding method. This greatly improves the hardiness of modeling to attain larger process efficiency Finally, the chuckholes we tend tore detected by comparison the distinction between the actual. the purpose dataset of the detected potholes was then extracted from the reconstructed road surface. In addition, we additionally created 3 datasets to contribute to stereo vision-based pothole detection research. Thus, we aim to style algorithmic program to phase the reconstructed road surfaces into a gaggle of localized planes before applying the projected chuckhole detection algorithm.

VII. FUTURE SCOPE

Potholes are a big problem and have become a hazard to you on the road beat the hassle we're offering this method the usage of device mastering and photograph processing, that can stumble on the pot holes and via way of means of doing so we can effectively address the difficulty.

Better street safety: Machines are not vulnerable to human-blunders and distractions, ensuing in fast and suitable responses in real- time street conditions. Reduced go back and forth time: With automobiles speaking thru one another Potholes are detected and notify to the person immediately. In destiny we will use this in Route maps for deciding on an optimum path, which street is suffering from potholes and that's extra stable to travel.

REFERENCES

[1] J. S. Miller and W. Y. Bellinger, "Distress identification manual for the long-term pavement performance program," United States. Federal Highway Administration. Office of Infrastructure Research and Development, Tech. Rep., 2014.

[2] S. Mathavan, K. Kamal, and M. Rahman, "A review of three-dimensional imaging technologies for pavement distress detection and measurements," IEEE Transactions on Intelligent Transportation Systems, vol. 16, no. 5, pp. 2353–2362, 2015.

[3] T. Kim and S.-K. Ryu, "Review and analysis of pothole detection methods," Journal of Emerging Trends in Computing and Information Sciences, vol. 5, no. 8, pp. 603–608, 2014.

[4] R. Fan, J. Jiao, J. Pan, H. Huang, S. Shen, and M. Liu, "Real-time dense stereo embedded in a for road inspection," in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops, 2019, pp. 0–0.

[5] C. Koch, K. Georgieva, V. Kasireddy, B. Akinci, and, "A review on computer vision-based defect detection and condition assessment of concrete and asphalt civil infrastructure," Advanced Engineering Informatics, vol. 29, no. 2, pp. 196–210, 2015.

[6] Y.-C. Tsai and A. Chatterjee, "Pothole detection and classification using 3d technology and watershed method," Journal of Computing in Civil Engineering, vol. 32, no. 2, p. 04017078, 2017.

[7] I. Pitas, Digital image processing algorithms and applications. John Wiley & Sons, 2000.

[8] S. Li, C. Yuan, D. Liu, and H. Cai, "Integrated processing of image and GPR data for automated pothole detection," Journal of computing in civil engineering, vol. 30, no. 6, p. 04016015, 2016.

[9] E. Buza, S. Omanovic, and A. Huseinovic, "Pothole detection with image processing and spectral clustering," in Proceedings of the 2nd International Conference on Information Technology and Computer Networks, 2013, pp. 48–53.

[10] C. Koch and I. Brilakis, "Pothole detection in asphalt pavement images," Advanced Engineering Informatics, vol. 25, no. 3, pp. 507–515, 2011.

[11] M. R. Jahanshahi, F. Jazizadeh, S. F. Masri, and B. Becerik-Gerber, "Unsupervised approach for autonomous pavement-defect detection and quantification using an inexpensive depth sensor," Journal of Computing in Civil Engineering, vol. 27, no. 6, pp. 743–754, 2012.

[12] R. Fan, X. Ai, and N. Dahnoun, "Road surface 3D reconstruction based on dense subpixel disparity map estimation," IEEE Transactions on Image Processing, vol. PP, no. 99, p. 1, 2018.

[13] C. Zhang and A. Elaksher, "An unmanned aerial vehicle-based imaging system for 3d measurement of unpaved road surface distresses," Computer-Aided Civil and Infrastructure Engineering, vol. 27, no. 2, pp. 118–129, 2012.

IJARSCT
ISSN (Online) 2581-9429
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[14] R. Fan, "Real-time computer stereo vision for automotive applications," Ph.D. dissertation, University of Bristol, 2018.

[15] Z. Zhang, X. Ai, C. Chan, and N. Dahnoun, "An efficient algorithm for pothole detection using stereo vision," in Acoustics, Speech and Signal Processing (ICASSP), 2014 IEEE International Conference on. IEEE, 2014, pp. 564–568.

[16] A. Mikhailiuk and N. Dahnoun, "Real-time pothole detection on tms320c6678 dsp," in Imaging Systems and Techniques (IST), 2016 IEEE International Conference on. IEEE, 2016, pp. 123–128.

[17] L. Cruz, L. Djalma, and V. Luiz, "Kinect and rgbd images: Challenges and applications graphics," in 2012 25th SIBGRAPI Conference on Patterns and Images Tutorials (SIBGRAPI-T), 2012.

[18] R. Hartley and A. Zisserman, Multiple view geometry in computer vision. Cambridge university press, 2003.

[19] M. A. Fischler and R. C. Bolles, "Random sample consensus: a paradigm for model fitting with applications to image analysis and automated cartography," Communications of the ACM, vol. 24, no. 6, pp. 381–395, 1981.