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The 2nd Universitas Lampung International Conference on Science, Technology, and Environment (ULICoSTE) 2021

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2021

2nd ULICoSTE

UNIVERSITAS LAMPUNG INTERNATIONAL CONFERENCE ON SCIENCE, TECHNOLOGY AND ENVIRONMENT

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Preface: The 2nd Universitas Lampung International Conference on Science, Technology, and Environment (ULICoSTE) 2021

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PREFACE

The Institute for Research and Community Services of Universitas Lampung was honored to host the Second Universitas Lampung International Conference on Science, Technology, and Environment (ULICoSTE) 2021. As a result of the COVID-19 pandemic, we were dealing with a paradigm of entirely online-organized event utilising Zoom.

As the world moves toward digitalization, where technology reigns supreme, this conference is dedicated to fostering synergy in science and technology through collaborative research for digital transformation. Additionally, the pandemic has compelled us to embrace digital technology. As a result, today's digital transformation involves collaboration across numerous stakeholders via diverse research and innovation efforts. Thus, the 2nd ULICoSTE 2021 Conference served as an opportunity to explore a variety of topics linked to our Conference theme, "Promoting Synergy through Collaborative Research in Science, Environment, and Technology for Digital Transformation."

The 2nd ULICoSTE 2021 conference promised to be both stimulating and informative, with a stellar line-up of keynote speakers from Murdoch University (Australia), Universitas Lampung (Indonesia), Universiti Teknologi MARA (Malaysia), and National Taiwan Normal University (Taiwan). The conference aimed to foster relationships and exchange theoretical and practical ideas and knowledge among those interested in collaborative interdisciplinary research in the areas of sustainable development, environmental science, remote sensing and GIS, climate change, renewable energy, and other related areas. This conference featured invited sessions and panel discussions with prominent speakers on a variety of scientific and technological research issues. All presenters and participants were able to meet and engage with one another online throughout the interactive sessions.

The current issue of AIP Conference Proceedings consists of 81 articles that represent a selection of the contributions presented at the 2nd ULICoSTE 2021. The papers cover a range of topics related to the conference's theme. We consider it an honour to provide the most recent scientific knowledge and advancements in the world of science and technology. Additionally, we believe that these proceedings will serve as a valuable reference book for researchers worldwide.

The conference is the culmination of the efforts of numerous individuals. As such, we would like to extend our gratitude to the members of the organizing committee for their efforts in ensuring the conference's success on a daily basis and to the reviewers for their hard work in reviewing submissions. Additionally, we appreciate the four invited keynote speakers for sharing their perspectives and knowledge with us. Finally, the conference would not be possible without the excellent papers contributed by authors. We would like to express our gratitude to all authors for their contributions and participation in the 2nd ULICoSTE 2021.

We look forward to seeing you next year at the 3rd ULICoSTE 2022.

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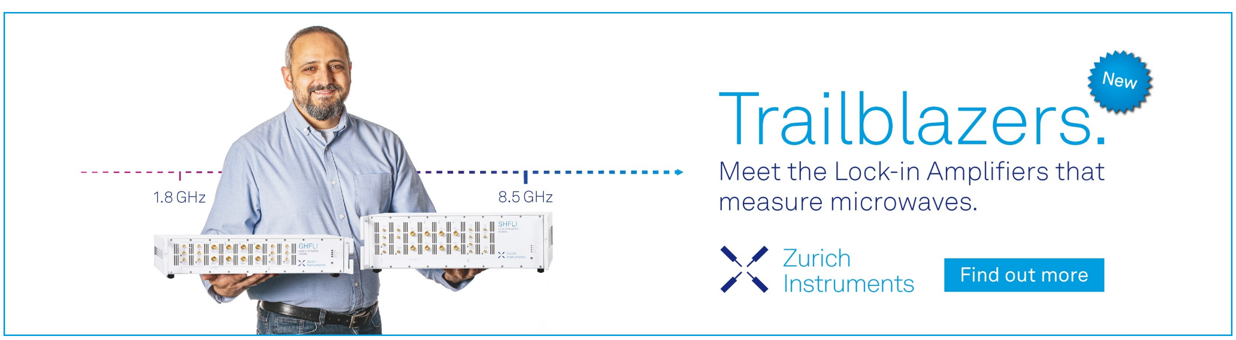

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Obstacle detection using Raspberry Pi for driving safety based on Hough transform method

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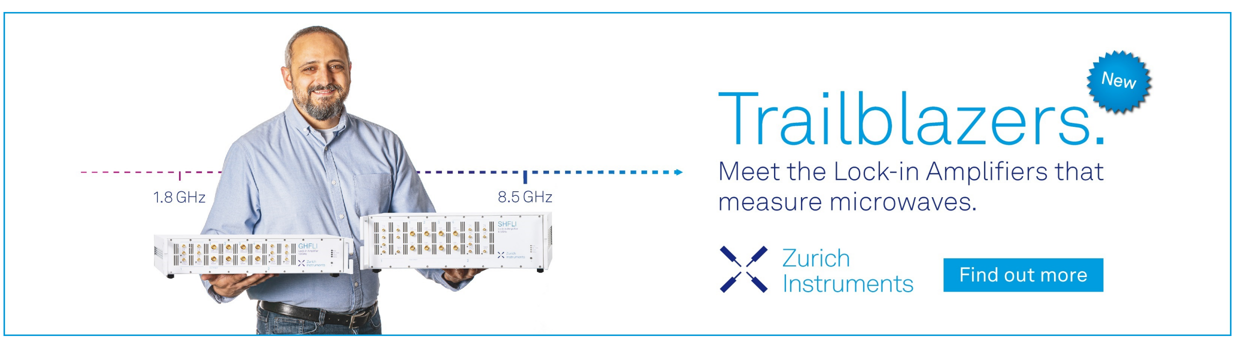

Obstacle Detection Using Raspberry Pi for Driving Safety Based on Hough Transform Method

Herlinawati[1, b)], Tiya Muthia[2, c)], Haedar Aziz Mahmud[1, d)], Sri Purwiyanti[1, e)], FX Arinto Setyawan[1, a)]

[1]*Department of Electrical Engineering, Engineering Faculty, Universitas Lampung.*
Jl. Sumantri Brojonegoro No. 1, Bandar Lampung, Lampung, Indonesia, 35145. Indonesia
[2]*Electrical Engineering postgraduate program, Engineering Faculty, Universitas Lampung.*
Jl. Sumantri Brojonegoro No. 1, Bandar Lampung, Lampung, Indonesia, 35145. Indonesia

[a)] Corresponding author: fx.arinto@eng.unila.ac.id
[b)] herlinawati@eng.unila.ac.id
[c)] tiyamuthia7@gmail.com
[d)] haedarazizmahmud@gmail.com
[e)] sri.purwiyanti@eng.unila.ac.id

Abstract. The rapid development of digital image processing technology can be used to simplify human life. This technology can be used in automotive technology which is also growing rapidly. Automotive technology leading to driverless automation cars is in dire need of image processing technology. This research aims to detect obstacle objects based on the detection of line changes emitted by line lasers. The line laser beam is captured using a camera and then using a Raspberry Pi to determine whether there is an obstacle or not. This research uses the Python programming language with the Hough Transform method. The Hough Transform method is used to detect lines in an image that is processed by looking at the consistency of the line laser. This research uses a box and a ball as obstacle objects. Research data collection was carried out in the afternoon in a closed room with an Illumination intensity of 10 Lux with parameters such as distance, camera angle, and line laser angle. An object can be said to be an obstacle if an image there is a laser line that is broken or not at the same pixel position. However, if in the image there is a consistent line or there is no line position change, then in the image there is no obstacle object. Based on the evaluation results of the calculation of the accuracy of the obstacle distance between the actual distance and the distance calculated by the program, the accuracy is above 90%.

INTRODUCTION

The development of image processing technology is inseparable from the rapid development of the computer world. The development of memory and central processing unit technology increasingly fast, supports image processing can be done in real time. This processing speed allows video processing to be carried out without delay. Video processing is image processing that is carried out based on processing successive image frames.

Image processing applications are widely used in everyday life. Many electronic devices utilize this technology for its control. In principle, image processing accommodates control based on a human vision by replacing the function of the eye with a visual sensor (camera). Image processing techniques can be combined with artificial intelligence methods to provide better control decisions.

Previous research on object detection has been many carried out. Detection of objects can be done using a stationary camera or a moving camera. Previous research on object detection was carried out using a moving camera. In this research, changes in the background position are tracked based on the displacement of the corner point features using the Haris Corner Detection and Lucas Kanade Tracker methods [1,2]. After the position of the background has the same position, the background subtraction operation of the current frame is performed with the previous frame.

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Other research uses two cameras that are installed side by side to detect the presence of 3-dimensional objects [3]. Tracking the corner point feature is carried out on the image on the right with the image on the left.

The use of the Hough transforms in detecting lines has also been widely studied. Many methods have been proposed in developing this method to detect lines such as probabilistic [4], progressive probabilistic [5], to the use of preprocessing filters [6]. Line detection using the Hough Transform can be applied to determine the position of the vehicle number plate [7]. The line that limits the vehicle number plate is detected using the Hough transform then if the information in it is in the form of letters and numbers then it is designated as the vehicle number plate.

Another object detection research uses a monocular camera that is applied to a UAV (Unmanned Aerial Vehicle) to collision avoidance [8] and a stereoscopic image processing that combines accumulating and thresholding techniques [9]. Research on object detection for outdoor environments has also been carried out. This research discusses the comparison of object detection methods using passive, active, and visual sensors [10]. Research on object detection using line laser guidance has also been carried out previously. The method used is labeled Blob Image and applied to a wheelchair [11].

This research proposes an obstacle detection method based on the detection of lines resulting from line laser beams using the Hough Transform method. This study aims to identify objects in front of the camera and estimate their distance with the help of straight lines emitted by laser lines at certain distances and angles. The definition of an obstacle in this research is a 3-dimensional object that is in front of the camera. This obstacle detection can be applied to help see the presence of obstacles in front of the vehicle to prevent accidents.

MATERIAL AND METHOD

This research uses a Laser Fog Lamp that is used to determine the presence of an Obstacle, a Logitech C270 webcam as image capture, Raspberry Pi Model B + which has installed the Python 3.5.3 programming language with OpenCV 3.4.4 Library, Buzzer, and 7-inch LCD as output from the device this. Obstacle objects are boxes and balls, with varying laser point distances, namely 100 cm, 150 cm, 175 cm, and 200 cm, respectively. The method of retrieving image data for research on obstacle detection equipment is shown in Fig. 1.

(a)

(b)

FIGURE 1. The method of retrieving image data on obstacle detection equipment (a) position of equipment and obstacles (b) data resulting from image capture.

The design of the system model of this system starts or runs until the system is deactivated by the user to be looped continuously. There are various methods in image processing including converting RGB images into LUV images, thresholding, morphology, contour, and Hough transformation as line detection while counting lines that have been detected by the edges. Looping from the system is stored in a file with the avi format which will then be extracted in the .bmp format so that several frames are obtained every second. The system model design uses the proposed method shown in Fig. 2.

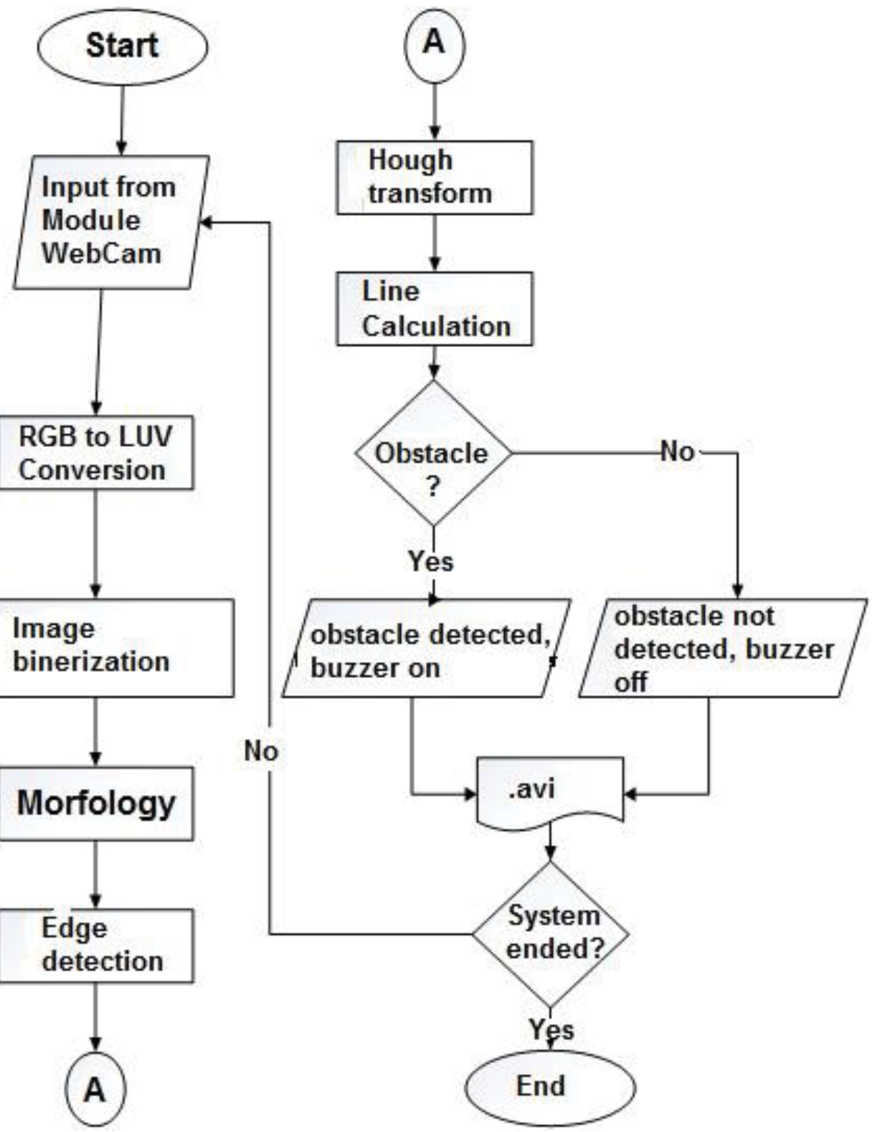


FIGURE 2. Flowchart of the proposed obstacle object detection method.

Image Preprocessing

The image preprocessing carried out in this system is to convert RGB images into LUV images. LUV image is a color space that can find color values without intensity effects on an image. This conversion is to overcome the shortcomings in the RGB color space, namely when two colors approach the same value, but in human vision, there are far differences. Then convert the image into a binary image (thresholding) with the type of Adaptive thresholding. Thresholding is used to classify the value of chromatization (UV) which is taken ie red just becomes black and white. Black and white images have 256 levels, meaning they have a scale from 0 to 255 or [0.255], in this case, the value 0 represents black, and the value 255 represents white, and values between 0 to 255 represent gray colors that lie between black and white.

The next process is to carry out a morphological process, namely the Opening process on the image. The opening process is a morphological process where the image is treated with an erosion process which is then followed by a dilation process. The Opening process aims to fill in small holes in unwanted objects or cover noise. The Opening process aims to fill in small holes in unwanted objects or cover noise. Furthermore, the contouring process is carried out to detect edges. This is to facilitate the next step, namely by recoloring the laser color that has been a threshold to green.

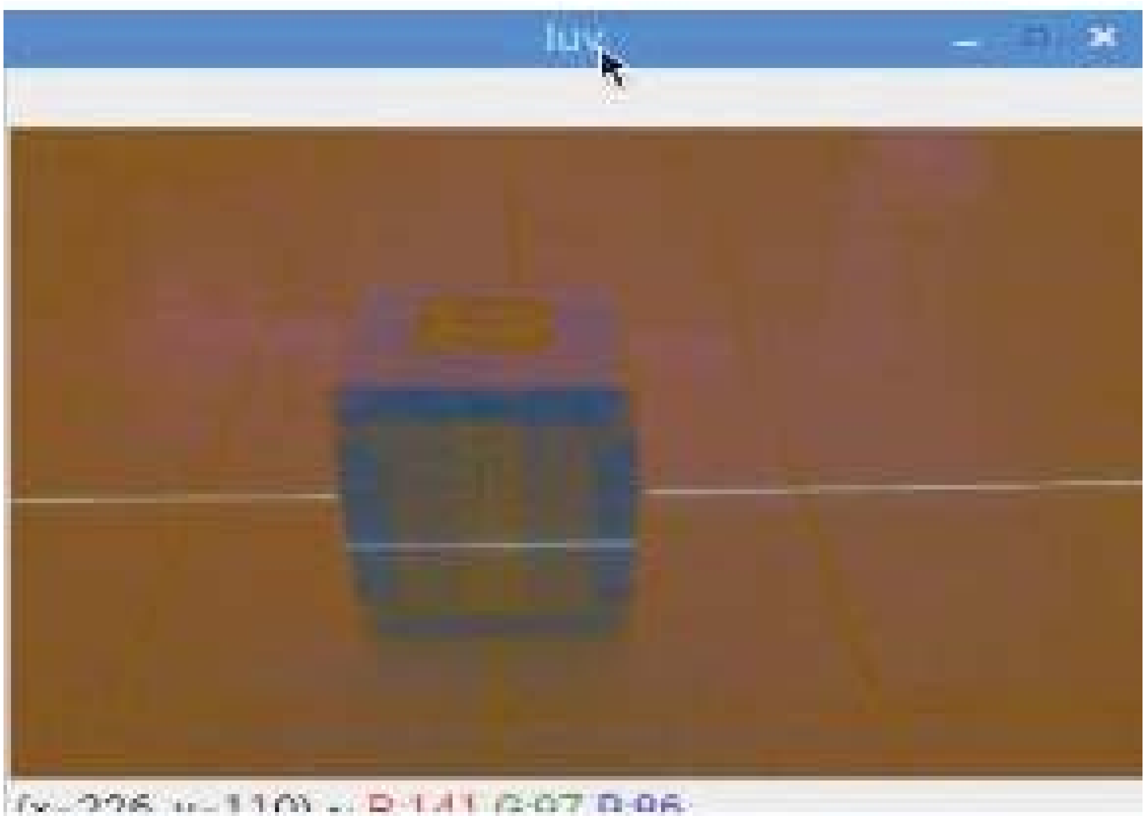
Final Processing Results

The next step after preprocessing is to detect straight lines using the Hough transform method. Hough Transform is an image transformation technique that can be used to isolate an object in an image by finding its boundaries (Boundary Detection).

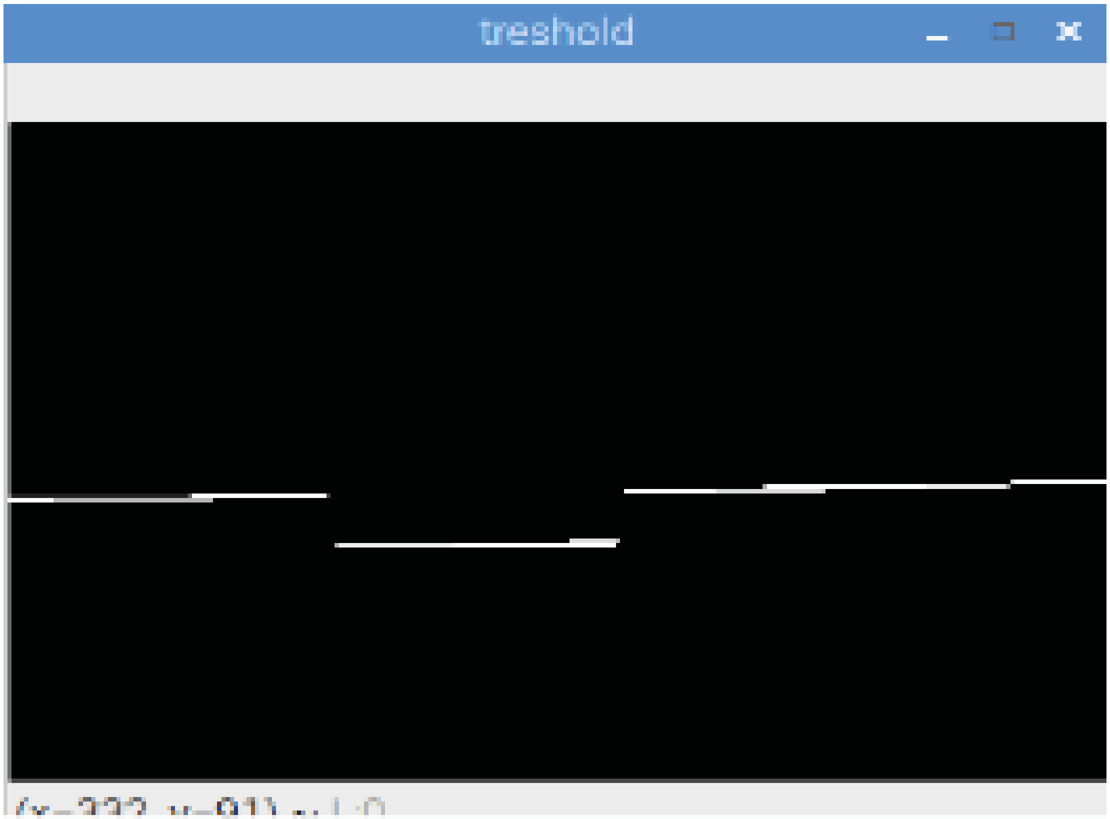
Images that have been detected by the Hough transform method will be seen marked with a green line. The green color is used to make it easier to find out the laser line that is detected. Lines that have been detected will be calculated by the system so that it can determine the conditions whether there are obstacles or not. The system will detect an obstacle if the counted lines have 2 or more then the system will give a warning in the form of red text and activate the buzzer as a warning when an obstacle is detected. And when the system counts only one line it will give notification in the form of text not detecting an Obstacle and deactivating the buzzer.

In this research, balls and boxes were used as obstacles with the laser distances to objects are 200 cm, 175 cm, 150 cm, and 100 cm. The results of image processing with box objects and ball objects are shown in Fig. 3 and 4. In Fig. 3 is the result of processing several stages. Fig. 3 (a) is an LUV image. Subsequently it was submitted through a thresholding image with a threshold value of 10-91 seen in Fig. 3 (b). Further processing is carried out morphology and contours to facilitate line detection using the Hough transform method shown in Fig. 3 (c). In Fig. 3 (d) there is an image that has been detected by a Hough transform.

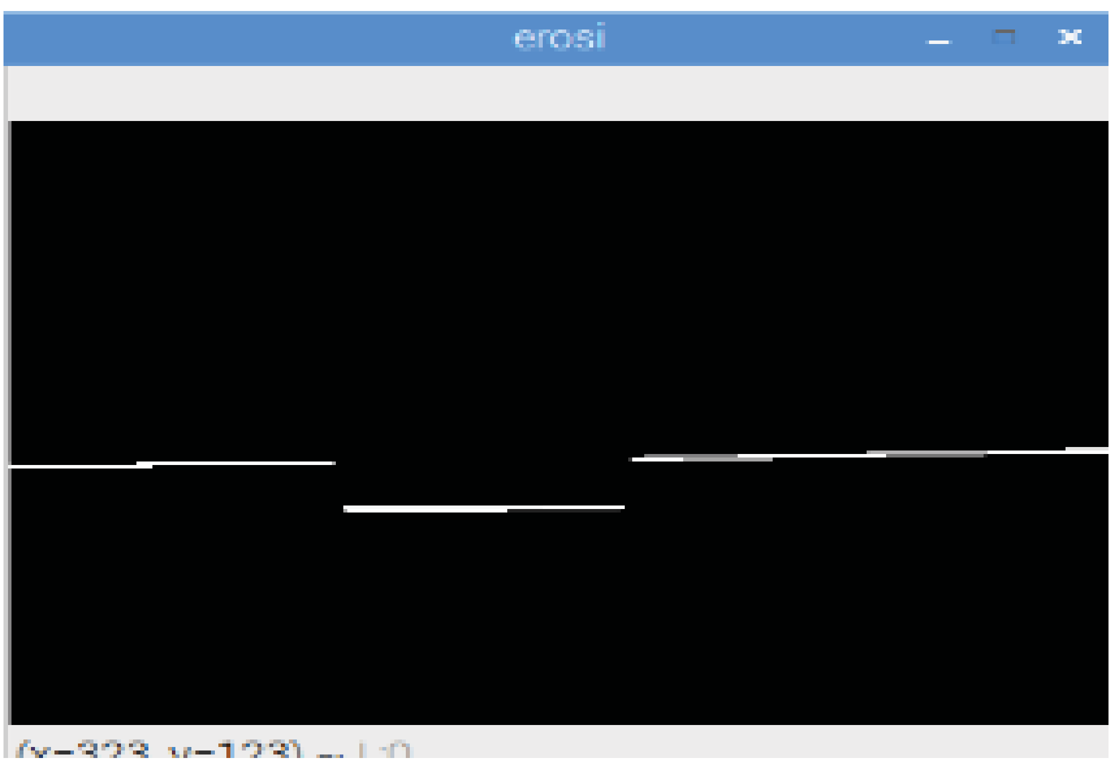
In Fig. 4 is the result of several stages of processing. Fig. 4 (a) is the original image or the RGB image. Subsequently it was submitted through a thresholding image with a threshold value of 10-91 seen in Fig. 4 (b). Further processing is carried out morphology and contours to facilitate line detection using the Hough transform method shown in Fig. 4 (c). In Fig. 4 (d) there is an image that has been detected by a Hough transform.



(a) LUV



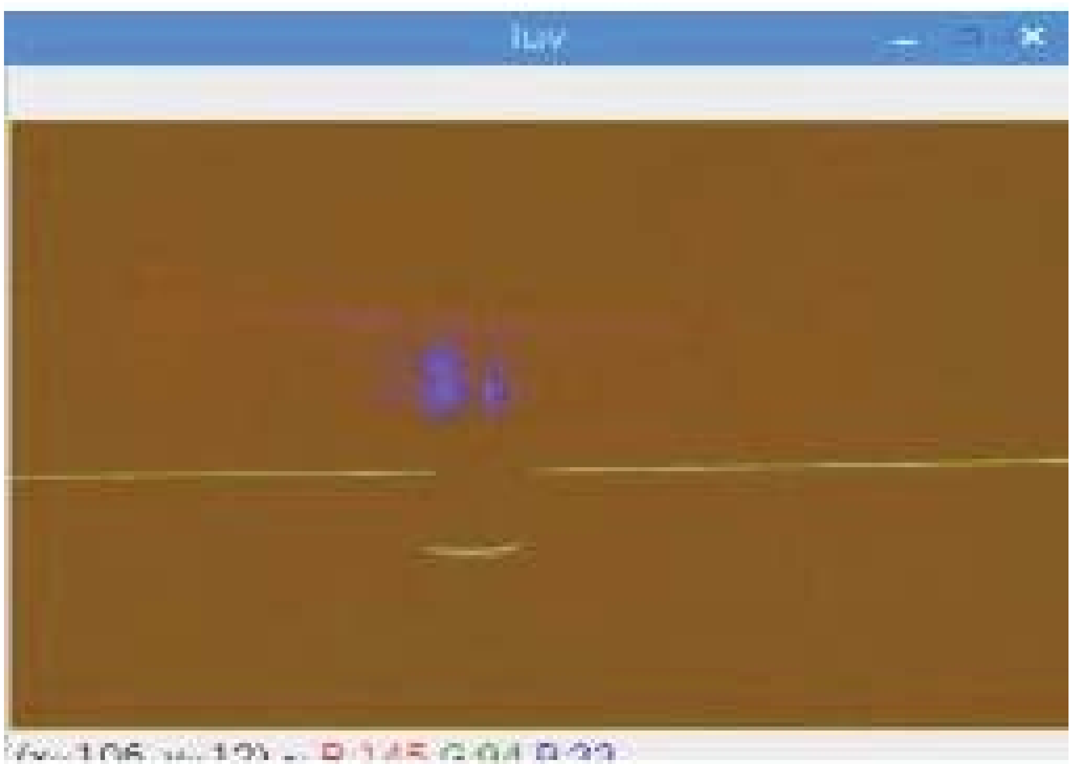
(b) Thresholding



(c) Morphology

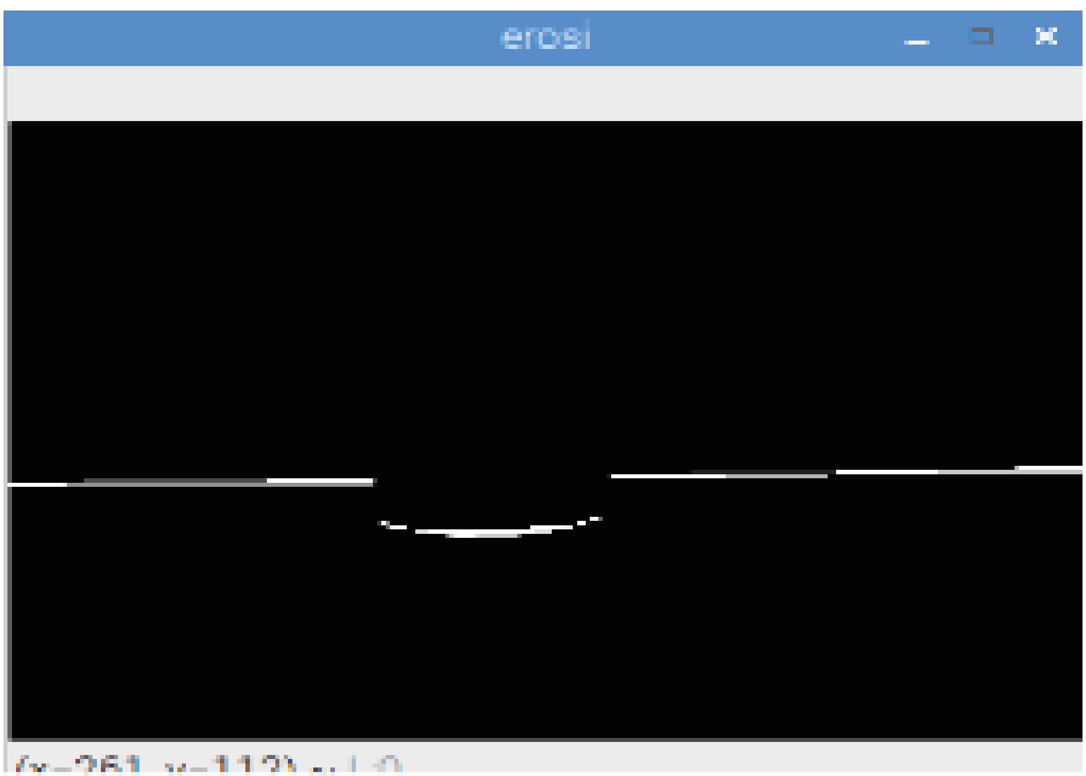
(d) Hough Transform

FIGURE 3. Final processing result with a Box object when the object distance is 100 cm



(a) LUV

(b) Thresholding



(c) Morphology

(d) Hough Transform

FIGURE 4. Final processing results with the Ball object when the object distance is 100 cm

Calculation of the number of obstructions in an image taken, the method used is to calculate from the camera projection angle per pixel multiplied by the number of pixels where there is a change in the line or the dotted line. Images that have been detected by lines will be added to the gridlines to facilitate the calculation of object distances. The gridline created is 40x30, because the processed image has a resolution of 400x300, 1 gridline box represents 10 pixels. The camera projection angle per pixel obtained is 31.89°, so the degree of each pixel is 0.1°.

The distance and angle of the camera and laser are measured when capturing the image. The measurement results show that the laser angle and camera angle are obtained when the length of the laser fall point is different (125cm, 150cm, 175cm, and 200cm respectively) with a laser height of 60 cm and a camera height of 85 cm are shown in Table 1. The calculation method of the camera and laser angles is explained by the illustrations shown in Fig 5 and the calculation method is described by equations (1), (2), (3), and (4) respectively. The results of line recognition using Hough transform with an obstacle distance of 75 cm is shown in Fig 6.

TABLE 1. Camera and laser angle values

Laser Point Distance (cm)	α (°)	β (°)
125	34.20	25.64
150	29.53	18.92
175	25.90	21.80
200	23.02	16.69

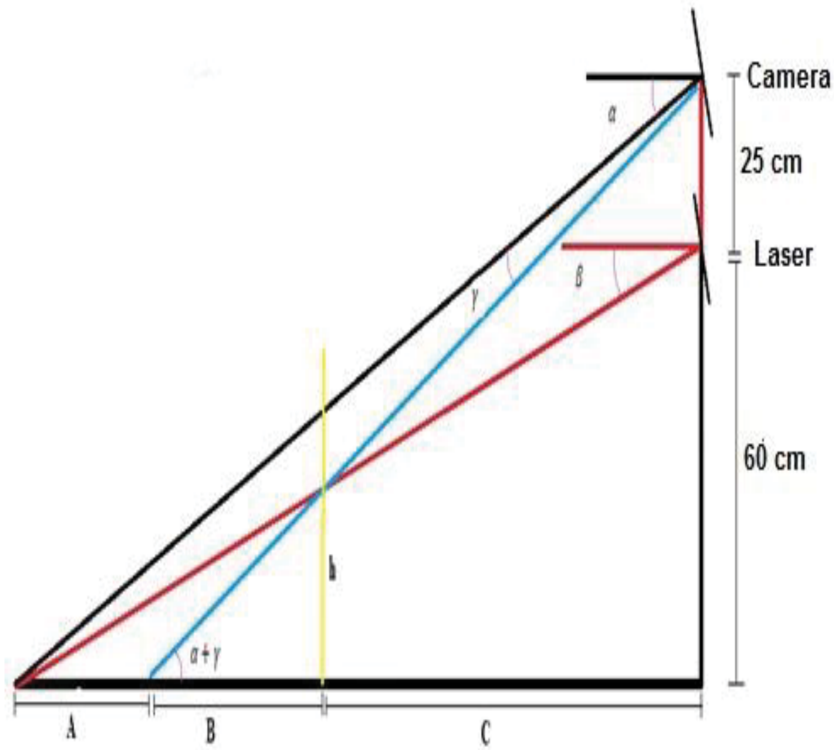


FIGURE 5. Illustration of Calculation and Distance.

$$\Delta - a = arctan\frac{x}{y} \tag{1}$$

$$A = Laser\ Point\ Distance - \frac{Hight\ of\ camera}{tan\ (\alpha+\gamma)} \tag{2}$$

$$B = A\frac{tan\ \beta}{tan\ (\alpha+\gamma) - tan\beta} \tag{3}$$

$$C = Laser\ point\ Distance - (A + B) \tag{4}$$

Where:
x = The distance between the camera and the laser with the object
y = Height camera and laser
Δ = Half angle of slope of triangle
h = Potition of Object
β = Angle of Laser
α= Angle of camera
γ = Angle of Obstacle Line Change
A = Distance of the shadow point to the laser point
B = Distance of the shadow point to the object
C = Distance of object

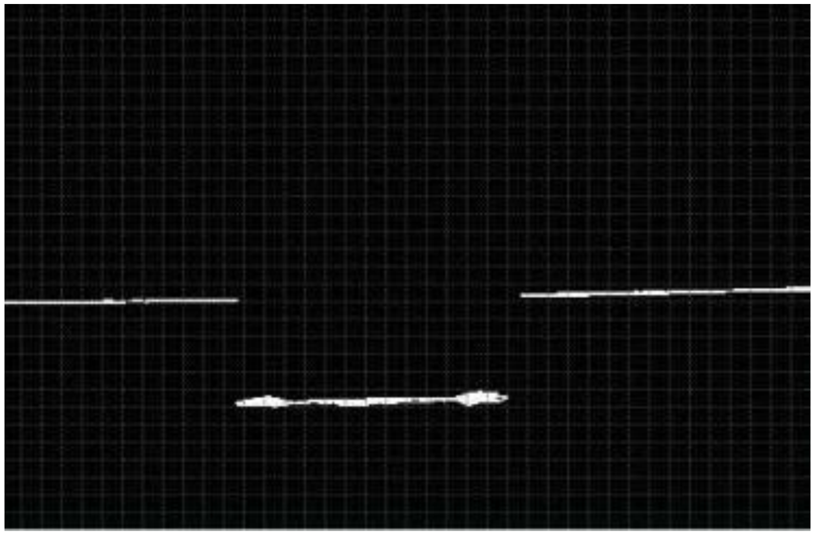


FIGURE 6. Image With 75cm Obstacle Distance

RESULT AND DISCUSSION

Image capture in this research was carried out at night indoors when the light intensity was 0.4 lux. The captured image file has a resolution of 400x300 pixels and the format is .avi. The obstacle line detection device is able to detect obstructions by detecting changes in the line of the laser beam that emanates then if detected, the Raspberry Pi will activate the buzzer. The analysis of the accuracy of the obstacle distance in this research is by calculating the percentage of the distance between the obstacles of the proposed method and the actual distance. For distance accuracy, it is not perfect because at the time of data collection the angle calculation is still done manually using an arc so that the angle used is not the same as the actual calculation, then the calculation of the percentage of distance accuracy is done by Equation (5).

$$\%\, Accuracy\ Dist. = \frac{Calculation\ Distance}{Actual\ Distance} \times 100\% \quad (5)$$

The percentage of the distance accuracy is defined as the calculated data divided by the actual data then multiplied by 100% (Equation 5). In this system, the percentage of accuracy of distance has obtained an average of 96.56% as shown in Table 2.

TABEL 2. Evaluation of calculation of obstacle distance to laser

Laser Distance (cm)	Data Retrieval Value (cm)	Calculation Value (cm)	Accuracy Distance (%)
125	75	68.5	91
	100	99.5	99.5
150	75	73.3	97.3
	100	95.47	95.47
	125	130	96
175	75	82.26	90.32
	100	98	98
	125	115.9	92.72
	150	152	98.67
200	100	98.3	98.3
	125	125.6	99.52
	150	150	100
	175	171.7	98.11
	Mean		96.56

CONCLUSION

Based on the results of measurements, calculations, and analyzes that have been done, the proposed method can detect obstacle objects in real time using a ball and box objects based on changes in laser lines. The percentage accuracy of the distance calculation with the distance when data collection is above 96.56%.

Further research can add the method of calculating the number of obstacles and calculating changes in the obstacle distance between one frame and the next frame to give better results. In addition, research needs to be done to apply it to various weather conditions, such as rain and bright light.

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