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Caracterization of the Green Pointer Laser Beam Value as an Obstacle Sensor on Various Background Colors

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Abstract- Obstacle detection sensor is an important development tool of autonomous vehicles in recognizing its environment. Green laser pointer is an example of a sensor in the form of visibe light beam to detect the obstacles that are in the track of the tractor. This research aimed to Determine the variation of green laser beam as an obstacle sensors in different backgrounds and different intensity of light. This system used a CMOS camera and cctv lense 0-60 mm of focal length as the prime sensor and a green laser pointer at 532±10 nm with a maximum of 98 000 mW output power. Asicap software used to capture the image of the green laser pointer and then the image processed by using ArcMap 10.5 to determine the coordinat of the green laser and its RGB pixels. The camera is capable to detect the green laser pointer beam with intensities up to 50000 lux° with Temperature 51.6 °C and 40.3% of humadity from 2 meters until 7 meters from Potition captured. From the tests carried out it appears that the normalization value of green laser light, especially for the maximum and minimum values of the components of green on various types of objects look the same. Especially for the minimum green value. This states that the various types of green laser beam sighting objects have the same minimum value, so the coding program will be the same.
Keyword: Green Laser Pointers, Sensors, CMOS Camera, Obstacle Detection, Visible Light

1. Introduction

Technology shows the way people utilize all the innovation in order to meet the needs in life. Technology makes human work easier, safer, and better. As a result of the process of thinking, technology is certainly geared to serve human thought. There are four main benefits that can be felt by humans to technology, namely an increase in production, layoffs, makes job easier, and higher living standards. Technology developments require the engineers to find new ideas in the field of agricultural techniques to further improvement of work effeciency. One of the ideas that resulted the most demanding issues in the last two decades is the Precision Farming (PF), as the main topic of this research which is the application of the automatic navigation system on agricultural tractors. Labor shortages and environmental resources are also taken into separate consideration for the needs of automatic navigation on a farm tractor. The purpose of automatic navigation systemin agricultural tractors are to address the declining performance of the tractor because of the fatigue of the operator, and to improve the accuracy and productivity of the operation of tractors in the agricultural farming activities.

Unmanned tractor, even after already using GPS technology (Global Positioning System) to recognize his trajectory, would still require the ability to recognize the terrain in front of it in order to avoid obstacles that may exist. One of the devices that can be used to identify the field in front of the tractor and avoid obstacles that might exist is the camera. However, the image captured by the camera will need to undergo some processing to detect possibility of obstacles in front of tractor. The trial of the characteristics hurdles sensor must be done before development and design detection tools done. Smart application directly conditioned tractor actual (real-time) to be run efficiently if the equipment and sensors are used appropriately.

An image processing program in real-time to detect obstacles in the path of the tractor work [1]. However, there is still a shortagewhich is a red laser beam is not visible on the image that was captured when the sun's intensity above 2000 lux. It is highly unlikely to be applied on the tractor that work during the day. Therefore, it must be subjected to the characterization of obstacle detection sensor which in this study using a green laser pointer beam with a test on a variety of background conditions and light intensity. The output in this study is the data based distributionof RGB value of green laser on a variety of backgrounds and light intensity.

2. Methods

This research was conducted from April to December 2019 in the Laboratory of Agricultural Equipment and Machinery Production and Management, Agriculture Engineering Study Program, Faculty of Agricultural Technology, Andalas University. The tools that used in this study are: a set of computers, a laser pointer with a wavelength of 520 nm, a 50 mm Fl camera lens, lux meter, thermohygrometer, soldering equipment, meter nuts and bolts, Arcmap version 10.5 and Asicap software. While the materials used in this study are acrylic 5 mm boards, angle iron, and vibration damping rubber. The stages of this research consisted of the preparation of tools and materials, the determination of optical specifications of the camera and laser point, the design of the camera holder and laser pointer, and the creation of a databased distribution of the normalized value of the green laser beam normalization in various background colors. To determine the specifications of the system that used, a preliminary study is carried out for the optical characteristics of the camera and laser points. Determination includes measuring the exact dimensions of the laser pointer holder, camera specifications with focal length specifications that match the tractor track conditions and the sun's intensity conditions in outdoor conditions when the tractor is applied during operating hours. After knowing the equipment specifications, the design of the camera and laser pointer are carried out. The camera (cctv lens) used is equipped with six green laser pointers with three positions each on the bottom and top of the camera as shown in Figure 1. The camera and laser pointer are combined in one holder. The laser pointer holder and camera greatly influence the uniformity of the distance of the beam to be emitted by the laser pointer.

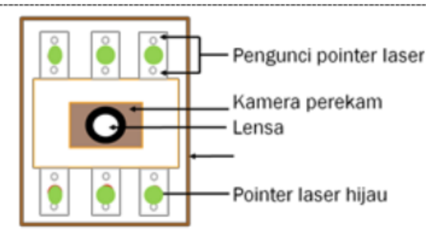

Figure 1 The Mounting Camera Holder and Green Laser Pointer and Their Parts

To determine the angle and position of the laser pointer on the holder, a trial and error method was carried out to obtain a parallel beam of red laser beam capable of representing the scene in front of it [2]. The adjustment components are carried out on the holder as shown in Figure 2 below.

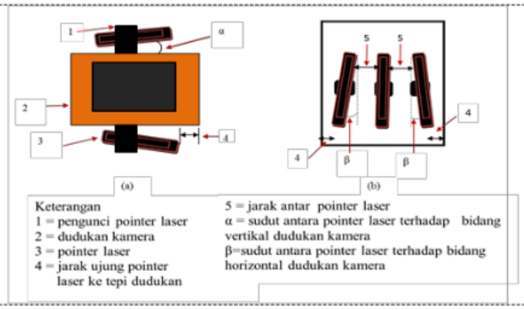

Figure 2 Setting the Placement of the Angle of the Laser Pointer and Camera on the Holder [3]

RGB (red, green, and blue) databased is a distribution of RGB green laser normalize data on a variety of background colors (objects). Making of databased aims to determine the interval of normalization rgb that can be used for all types of backgrounds and all levels of light intensity. The camera will capture (image capture) on some objects that have been illuminated by a green laser pointer. Making of databased done 12 treatments and each treatment was repeated 6 times. This treatment includes 12 types of backgrounds (objects). Measurements of the sun's intensity, humidity, and air temperature are carried out when shooting outdoor images.

3. Results and Discussion

3.1 Obstacle Detection System

The manufacture of mechanical systems involves making obstacle detection system components that have been designed in the previous stages such as laser pointer stands, camera mounts, and overall system support frames. The power source for all components comes from a battery contained in a 12 volt voltage tractor. While the other components in the obstacle detection system have a voltage of less than 12 volts so that the existing voltage source needs to be lowered using a simple voltage-reducing circuit. The picture of obstacle detection system can be seen in Figure 3 below.

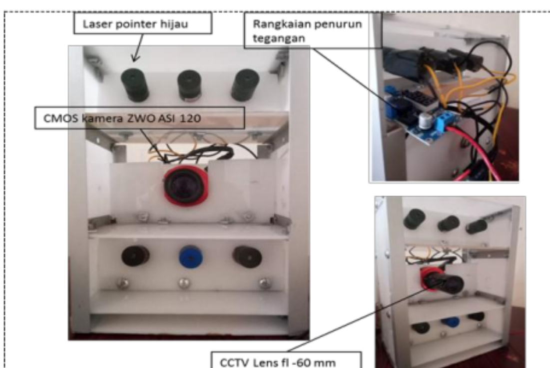

Figure 3 Obstacle Detection System

3.2 Green laser pointer image processing

The image is taken at outdoor environment using a camera with the help of the Asicap software which is then processed by using Arcmap software version 10.5. Figure 4 below is a picture of some appearance of a green laser pointer beam on various backgrounds. The red circle in the picture shows the presence of a green laser pointer beam.

Figure 4 Green Laser Beam Image on Various Background Objects

The captured image is processed using Arcmap software version 10.5. The output of this software is the RGB value in the region specified in the image. In this case the area in question is the reflection of green on the object due to green laser beam emission. The process of determining the green laser beam RGB value on an object can be seen in Figures 5 and 6 below.

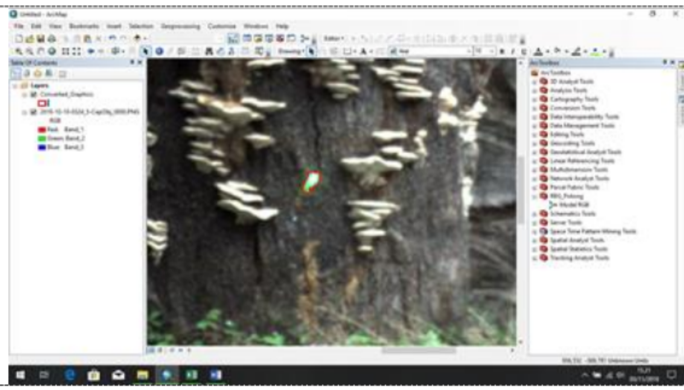

Figure 5 Green Laser Beam Image on the Background of A Wooden Object

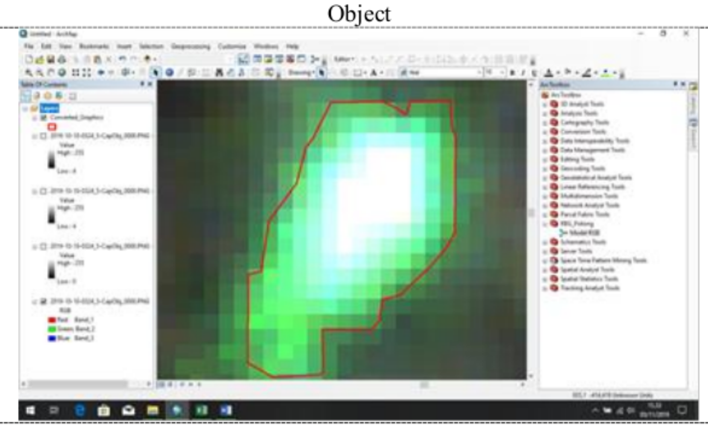

Figure 6 Making the Boundaries of the Green Laser Beam Region on the Image Using the Arcmap Application

The image of the object with green laser light taken at 12 treatments each taken at a distance of 2, 3, 4, 5, 6, and 7. After processing, the difference in the number of green laser pixels captured at each different distance is obtained as shown in Figure x below. At a distance close to the object, the number of green laser pixels will be greater than at a distance far from the object. The number of laser pixels captured does not affect the program's ability to read obstacles in this case in form of laser dots. However, the more the number of laser pixels captured is expected the higher the color intensity, especially the green color, and the more clearly visible contrast with the background. Image changes in the number of green laser pixels at each distance can be seen in the following Figure 7.

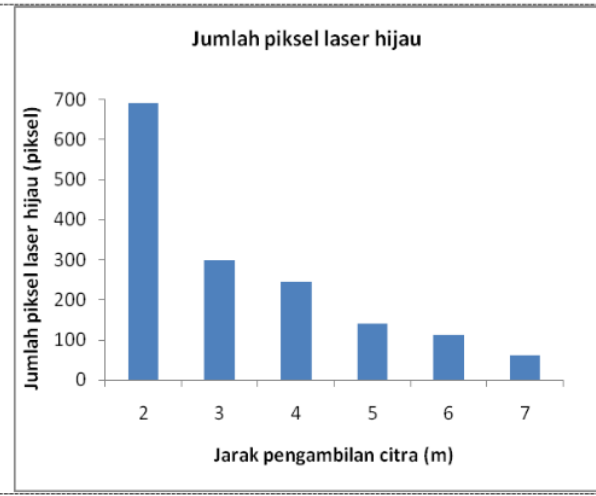

Figure 7 Changes in tThe Number of Green Laser Pixels at Each Distance

For each treatment given a different code, namely, Pnt, Rpt, Ppt, Pns, Rps, Pps, Rms, Rkr, Smr, Pkr, Dmr, and Tmr. Each of these codes shows the image of a green laser beam on an object with a different intensity. After anova test consisting of 12 treatments, the significant values obtained are in Table 1 below. Based on these results the significant value generated <0.05 where the smallest value is found in green at max value while the largest value is found in green at minimum value. Based on this, it is necessary to do further duncan test.

Table 1 Significant Values for All Treatments

Parameter		Nilai Significant
Red	Max	0.001111803
	Min	3.23E-07
Green	Max	5.48E-14
	Min	0.01763797
Blue	Max	7.96E-04
	Min	6.12E-13

Duncan's further test results can be seen in Table 2. After Duncan's further tests, the results obtained at the maximal value of RED. From the average value in the treatment of RPT, PNS, RMS and PPS smaller than the PNT and DMR treatments, while the DMR treatment is between PPT, TMR and PNT, TMR and PPT treatments are among all treatments, while the RPS, SMR, RKR treatments , and PKR are among the RPT, PNS, RMS, PPS and DMR but smaller than PNT treatment.

Table 2 Duncan Further Test Results

Perlakuan	Parameter					
	Red		Green		Blue	
	Max	Min	Max	Min	Max	Min
Pnt	0.4027c	0.1587ab	0.4952b	0.2531a	0.4409c	
Rpt	0.3319a	0.1242a	0.6111cde	0.3491b	0.4287bc	0.2135bcd
Ppt	0.3668abc	0.1287a	0.5790c	0.3281b	0.4283bc	0.2135bcd
Pns	0.3368a	0.2482c	0.4422a	0.3333b	0.3680a	0.2815f
Rps	0.3459ab	0.1558ab	0.5920cd	0.3333b	0.3996ab	0.2363de
Pps	0.3398a	0.1524ab	0.5858cd	0.3333b	0.3939ab	0.2237cd
Rms	0.3370a	0.1858b	0.5089b	0.3333b	0.3814a	0.2740fg
Rkr	0.3479ab	0.1583ab	0.5877cd	0.3333b	0.3860a	0.2165bcd
Smr	0.3469ab	0.1248a	0.6422e	0.3333b	0.3944ab	0.1913ab
Pkr	0.3647ab	0.1657ab	0.5994cde	0.3333b	0.3875a	1982abc
Dmr	0.3838bc	0.1551ab	0.6325de	0.3318b	0.3961ab	0.1738a
Tmr	0.3702abc	0.1858b	0.5680c	0.3333b	0.3813a	0.2049bc

After Duncan's test, the results obtained at a minimum RED value from the average value in the treatment of RPT, SMR and PPT are smaller than the treatment of civil servants, RMS and TMR, treatment of PPS, DMR, RPS, RKR, PNT and PKR are between TMR treatments , RMS, RPT, SMR and PPT, for the treatment of TMR and RMS is greater than RPT, SMR and PPT but smaller than the treatment of civil servants. After Duncan's test, the results obtained on the Green maxinal value of the average value in the treatment of civil servants are smaller than the entire treatment, PNT and RMS treatments are greater than civil servants and smaller than TMR, PPT, RPS, RKR, RPS, PKR, RPT, DMR and SMR, for the treatment of TMR and PPT are greater than PNS, PNT and RMS, but smaller than DMR and SMR. The treatment of RPS, RKR, DMR, PKR, RPT and RPs are between TMR, PPT and SMR, while the treatment of PKR and RPT is between TMR, PPT, PPS, TKR, RPS, DMR and SMR, while the treatment of DMR is between treatments of PPS, RKR, RPS, PKR, RPT and SMR.

After Duncan's test, the results obtained at the min value of the average value in the treatment of PNT treatment is smaller than the whole treatment. After further testing Duncan, the results obtained at the maximum value of BLUE from the average value in the treatment of civil servants, TMR, RMS, RKR and PKR, smaller than PPT, RPT and PNT. While the treatment of PPS, SMR, DMR and RPS are among PNS, TMR, RMS, RKR, PKR, PPT and RPT, PPT and RPT treatments are between PPS, SMR, DMR, RPS, DMR, RPS and PNT. While PNT is between PPT and RPT and smaller than other treatments After Duncan's test, the results obtained at BLUE min value from the average value in the treatment of DMR treatment, smaller than the entire treatment, SMR and PKR treatment are between DMR, TMR, PPT, RPT and RKR and smaller than other treatments. The treatment of TMR, PPT, RPT, RKR are between SMR, PKR and RKR, the treatment of PRS is between the treatment of PPS, RKR, RPT, PPT and PNT, the treatment of PNT is between the RPS and RMS. While the treatment of RMS between PNT and PNS, for PNS treatment is greater than the whole treatment except RMS.

The lower the value of the light intensity, the reflection for the red color component tends to increase both for the maximum and the minimum value. Likewise, the green color, the value of maximum normalization tends to increase while the minimum value has the same value for all intensities. For blue, the maximum and minimum values of green normalization have the greatest value at moderate intensity.

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4. Conclusion

Based on the results of tests that have been made, the database distribution of RGB values on various types of objects has been obtained and will be used later for the coding of obstacle dropping programs (green laser beam detection) with green laser color as obstacle sensors. From the tests carried out it appears that the normalization value of green laser light, especially for the maximum and minimum values of the components of green (green) on various types of objects look the same. Especially for the minimum green value. This states that the various types of green laser beam sighting objects have the same minimum value, so the coding program will be the same.

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