Intelligent Adjusting System of Headlights based on Machine Vision

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Abstract. Based on the study of the causes of nocturnal traffic accidents, it is found that the poor lighting of automobile headlights at night is one of the main reasons. In order to solve this problem, an intelligent adjustment system of headlights based on machine vision is designed. Through the binocular camera to collect images, its detection and identification processing, prejudge the road ahead is straight, up and down slope, or bend, and whether there are people with the car in front, so as to drive the lights to make corresponding adjustments. This system can realize the adjustment of the headlights in the horizontal and vertical direction, according to the road conditions to do real-time intelligent adjustment, but also to achieve the brightness of the lamp adjustment, to achieve anti-glare effect. In order to achieve safe lighting, improve the safety of night driving.

Keywords: Automobile headlight machine Vision Vertical adjustment Horizontal adjustment Brightness adjustment Motor drive.

1. Intelligent Adjustment Principle

With the rapid development of intelligent driving, the intelligent requirements for automotive components are becoming more and more high, each component is no longer just playing its single role alone, but into a variety of sensors to feedback and coordinate with each other, work together, cascade up to play a more intelligent role[1].The intelligent headlight system described in this paper improves its intelligence in the aspect of automobile headlight. In addition, machine vision technology has the intelligence of learning and memory on the one hand, and avoids the complexity and instability of multi-sensor cascade circuit on the other. Through the real-time monitoring of road conditions by machine vision, as well as the road information obtained through image processing, the adaptive adjustment of corners, ramps and anti-glare brightness is achieved, the problem of blind lighting in the night and poor lighting is solved, the safety hidden danger is reduced, and the safety of driving is improved.

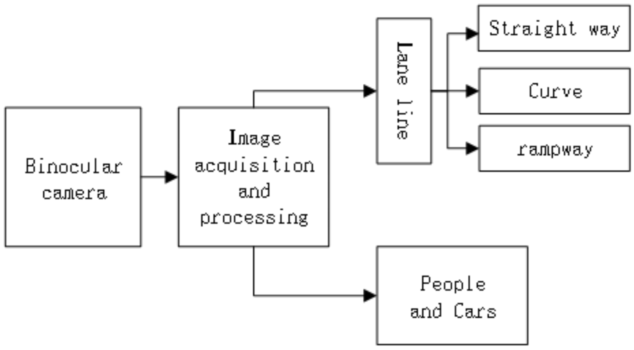

Figure 1. Intelligent tuning of the overall framework

The picture above shows the overall frame of intelligent adjustment, gives the main module of machine vision, that is, binocular camera, plays its important role in the industrial field, according to the processing results of the image collected to extract information, reflect the road conditions, for intelligent regulation to provide accurate road information[2].

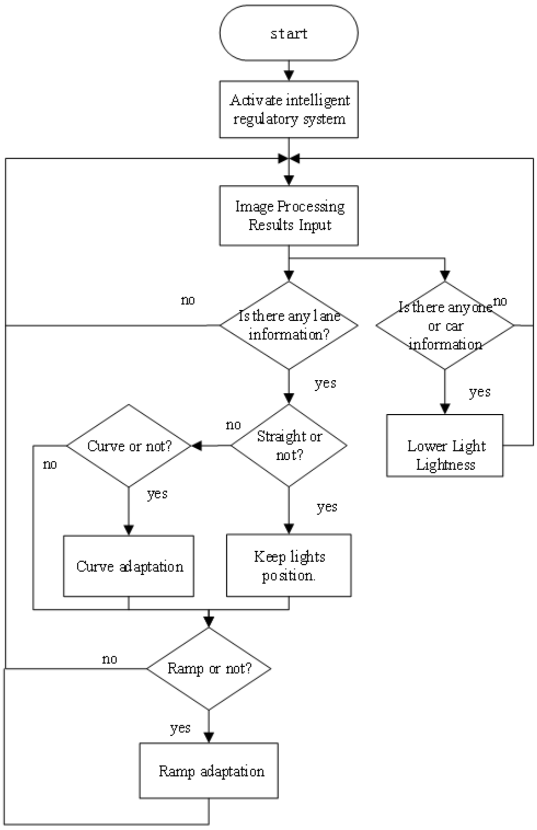

Figure 2. System Master Programming flowchart

Figure two is the system Master programming flow chart, according to the image processing extraction information into the corresponding logo parameters, accurate control of the lamp angle and brightness.

2. System Design Scheme

2.1 Lane Line Identification

At present, the main algorithms used in lane line recognition are as follows: First, the image is corroded and inflated to a certain extent, so as to remove some smaller influencing factors, then the main recognition part of the image is selected by Roi function, which is generally the next two-thirds part of the picture, and then the canny edge algorithm is used to depict the edge of the approximate object. Then with probabilistic Hough, that is, Hoff probability algorithm for the selected edge of the binary will be selected in a straight line, and its extension line can be traced to get the corresponding lane [3]. The linear slope filtered out in the process of Hoff transform will be the main basis of the later algorithm.

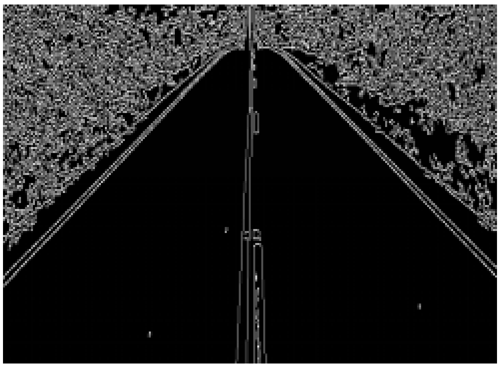

Figure 3. Straight-track image processing results

The picture shows the typical straight road condition, whose image processing results are characterized by narrow and lower width, intersecting trend in the distance, according to this characteristic, the image processing results are transmitted to the Motor Drive command, the headlights continue to maintain the original position and brightness, do not make adjustments.

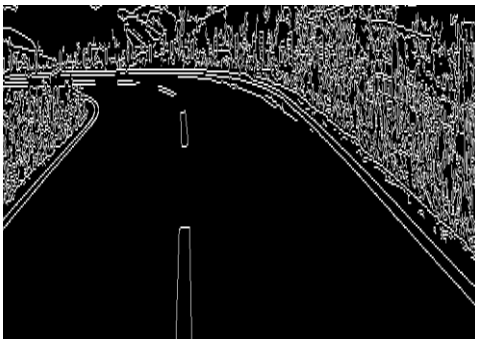

Figure 4. Left Turn bend image processing Results

Figure 5. Right turn channel image processing results

The picture shows the image processing result of the road condition, in the movement to the bend, because the lamp illumination range changes relative to the steering wheel rotation has a certain lag, therefore in the turn will appear the bend inside the lighting blind area problem, causes the huge safety hidden danger, is easy to cause the traffic accident due to the poor lighting. However, through this system, the front can be detected as a bend, the corresponding mark will drive the motor to make the left or right deflection, so that almost at the same time with the steering wheel rotation, timely to provide good lighting effect. The degree of road bending will be characterized by the corresponding marker parameters, so as to accurately control the horizontal rotation angle of the headlights.

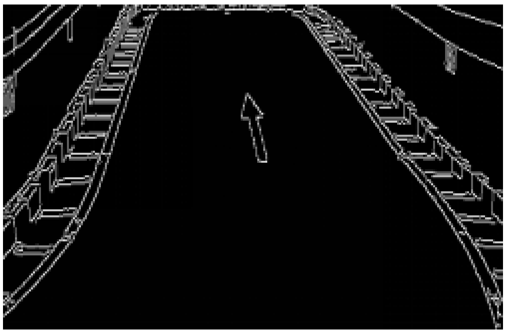

Figure 6. uphill image processing results

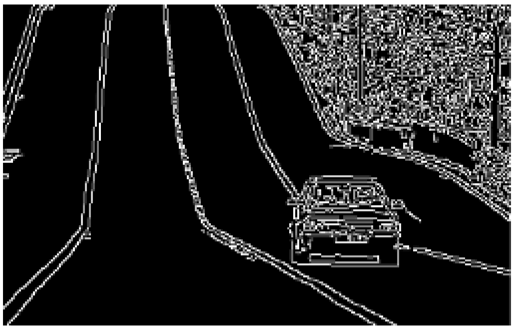

Figure 7. Downhill image processing results

The picture shows the results of image processing of the ramp road conditions, which are uphill and downhill, respectively. The difference between the results of Uphill road handling and the results of straight-track treatment is that the straight line intersects with each other in the distance, while the uphill is flat and the lane lines disappear at the top of the slope. When downhill road conditions, the results of its image processing will first narrow and widen the trend, narrowing the place is the bottom of the slope.

2.2 Identification of People and Cars

Figure 8. Identification of pedestrians

Figure 9. Identification of vehicles

Lighting in the night driving pros and cons, the brighter the lights in the night has the better lighting effect, but the light will also cause glare, car when the car lights too strong will make the driver dizzy, in the sidewalk when the vehicle lights too strong will make pedestrians dizzy. The intelligent adjustment of the system can be through the detection and identification of people and cars, drive the power of the headlights, slightly reduce the brightness of the headlights, in the premise of ensuring lighting to effectively solve the problem of dizziness.

3. Intelligent Tuning Implementation

3.1 Motor Level and Vertical Adjustment

3.1.1 Motor Horizontal Adjustment

Because the headlight illumination range is fixed, the car in the night turn lighting range is reduced, can not accurately provide the driver with the scene information of the front section, the driver does not have sufficient time to respond to the danger that may be faced. According to the machine Vision acquisition image and the processing results of the bend road, the system calculates the deflection angle and adjusts the illumination range of the light. The aim is to shorten the driver's response time by expanding the driver's vision, which can effectively reduce the occurrence of traffic accidents.

When the car turns at night, the horizontal adjustment angle required by the headlight is calculated according to the captured image information, and then the running frequency, direction and pulse number of the rotating stepper motor are calculated by the control algorithm, the output to the rotating stepper motor controller, the rotating stepper motor is driven, and the direction of the headlight beam irradiation is adjusted in real time. In order to meet the requirements of car drivers for night driving lighting, to enhance the lighting on the inside of the bend, enhance the lighting effect of night driving, improve the active safety performance of the car[4].

Stepper Motor Drive Plate selected Ansenmei NCV70627 as stepper motor drive chip, the accuracy of up to 1/16 rpm Stepper Drive, Lin Bus transceiver and other functions. The Stepper motor Drive module is proposed to form the Stepper motor Drive module of the system with double H bridge Motor Drive chip L298N and Japanese NMB motor PL35L-024[5]. In the horizontal adjustment of the headlights, the national standard stipulates that the adjustment range is 8°~15°, where in the left headlight is slightly different from the right headlight.

3.1.2 Motor Vertical Adjustment

When the car to the ramp section, due to the installation position of the headlights, resulting in the vehicle uphill when the process is shorter and can not accurately judge the other side of the car, the vehicle downhill but caused to the vehicle driver dazzling problems, in order to achieve better lighting effect, the headlights need to be adjusted vertically, according to the machine vision to collect images and processing results, The slope information of Lane line is analyzed and the angle of ramp is calculated.

When the vehicle to the bottom of the slope ready to go uphill, because the ramp barrier caused the light illumination process is low, so the front headlights should be adjusted to the vertical direction of the angle of exposure, you can change the illumination process, and when the vehicle to the top of the slope ready to go downhill, due to the high lighting projection caused to the car driver dazzling problem, Therefore, the front headlights should be adjusted to the vertical direction of the angle of irradiation, you can avoid causing glare to the opposite driver. If the ramp is a continuous upper and lower ramp (such as hilly area, Panshan highway, etc.), when the vehicle downhill close to the Slope Valley, the vehicle headlight needs to adjust the appropriate angle to expand the driver's night view.

Through the image processing results obtained by machine vision, the slope information of Lane line is obtained, and the angle of ramp is obtained according to the slope information, so as to calculate the angle of adjustment required by the lamp, in this adjustment, the national standard stipulates that its adjustment range is -3°~5°. If the machine vision recognition to the front 150m in the forward to the vehicle approaching, then through real-time measurement of its vehicle position to the far light pitch angle adjustment, to ensure that the long light is not directly to the driving driver, to prevent glare, according to the national standard, near light irradiation distance is generally 30 to 40 meters, Therefore, when the vehicle is 50 meters away from our vehicle immediately turn off the far light, and the high light angle of irradiation back to the original height, in case of the next long-distance lighting demand.

3.2 Control of the Brightness of the Headlights

The control of the brightness of the headlights is mainly aimed at the current lights in a certain lighting direction to determine the state, in order to its irradiation direction within the range of people and vehicles do not produce dazzling problems without affecting the current normal driving of our drivers under the premise of intelligent control of the brightness of the headlights. According to the national standard of the headlights and other provisions, the direction of the exposure of the NIR to have a clear and obvious light and dark cutoff line, and its irradiation height is generally around 60cm~90cm, will not cause obvious dazzling effects on the vehicles and pedestrians in front, and the far light is generally a divergent light source, and the irradiation height is also farther, which will have a serious dazzling effect on motorists and pedestrians in front of them, so the brightness regulation here is controlled for the brightness of the high light.

The brightness regulation of the long light lamp can be mainly based on the PWM wave voltage control and the current size control of constant current source, which is defined as the dimming duty ratio and the current ratio respectively, to realize the power regulation of the headlights, and then to complete a certain range of headlight brightness changes. The LED driver chip used here is the NCV78663 chip of ASM, which is illustrated by its dimming experiment on the light beads.

Table 1 is the NCV78663 series 1W lamp beads voltage Output measurement experimental data table, where the chip current ratio is set to a fixed value of 0%, by changing the voltage output PWM wave low level of the duty-free ratio, that is, the size of the dimming duty, to obtain different cases through the light beads of the current and its two ends of the voltage, The experimental data in the table show that the increase of modulation light duty ratio, voltage and current show a significant downward trend, and the corresponding lights continue to decline. Table 2 is the current output measurement experimental data table of NCV78663 series 1W beads, by keeping the default dimming duty ratio, that is, 0%, changing the current ratio, that is, the current size of the constant flow source in the chip, the experimental data show that with the increase of the current ratio, the voltage at both ends of the lamp bead and the current passing through are rising, The increase of current is very obvious, when the current ratio reaches 90% and above, the lamp beads will overheat and burn, so the brightness of the lamp beads have a larger adjustment space.

Table 1. Voltage output Measurement of NCV78663 series 1W lamp beads

1 channel 1w-led Drive, current proportional ≈0%, adjusted dimming duty-free ratio												
Dimming ratio	%	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	94.14
Series Beads	LED/mA	40.79	39.39	33.29	28.87	24.30	23.90	15.21	10.72	6.32	2.97	1.43
	Vled/V	8.12	8.05	8.00	7.92	7.85	7.76	7.69	7.61	7.53	7.46	7.44

Table 2. Current output measurement of NCV78663 series 1W lamp beads

1-channel 1w-led Drive, dimming duty-free ≈0%, adjusted current ratio Set the current setting parameter to X, the current adjustment ratio =x/128*100%								
Current ratio	%	0	20	40	60	80	90	100
Series Beads	LED/mA	48.2	262.4	459.0	670.0	803.0	Can't hold it. The lights burn quickly.	
	Vled/V	8.10	8.67	9.24	9.62	9.67		

4. Concluding Remarks

Based on the machine vision technology, this paper designs an intelligent adjustable automobile headlight system, collects images through binocular camera and processes the traffic information, obtains the parameter index of straight, bend, ramp and someone and vehicle, and uses the automobile grade MCU main control unit to deal with the motor level, vertical adjustment, and light brightness adjustment. In the driving process according to the actual road conditions to make real-time adjustment of headlights, to ensure that in different road conditions can be good lighting, greatly improve the safety of night driving. At the same time, the use of multiple samples for machine vision training and memory, more intelligent, its circuit relative multi-sensor technology is also more concise, more integrated. In addition, this intelligent adjustment system also provides a technical reserve for driverless night driving.

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