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RESEARCH ARTICLE

ADAPTIVE FRONT LIGHT SYSTEM.

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Abstract

The highest traffic accidents are occurs at night time. At night time people travels with conventional headlamps are particularly unsafe. About 25% of driving done at night time out of which 55% of accidents are occur during this periode.The conventional headlamp system does not provide illumination of light in right direction and at the precise angle, because of this it is a need to understand the alternative technology solution.

The paper, presents an Adaptive Front Light System (AFS) for better illumination of light at night time during curved road. It is an additional feature in today's vehicle which improves safety of vehicles driver as well as passenger which are travels at night time.

When vehicle is driven on the curved road then, In AFS headlamps do the horizontal movement by using image processing. According to the distance between subject vehicle and incoming vehicle, AFS headlamps does the vertical movement.AFS improve the accuracy and reliability of the headlamp which result in human safety. To overcome disadvantage of traditional headlight system possible improvement proposal and algorithm are provided.

Introduction:-

In recent decades road accidents are rapidly increasing. Road accidents are human tragedy. About 70% accidents are occurs in night time and 30% accidents are occurs in day time. Road safety is an issue of national concern. Accidents have negative impacts on economy, public health and public safety.

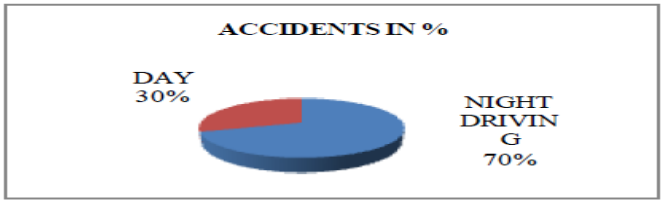

Fig 1: Graphical survey of accidents in percentage.

The conventional headlamp provides illumination of light only in tangent direction of the headlamp. It is not consider the turning of the road and distance between incoming vehicle and subject vehicle. Therefore driver get the incomplete and unreliable view of the road. Because of this it is necessary to do research on new technology.

Different researchers across the globe studied Adaptive Front Light (AFS) system as an innovative technology.AFS controls the light distribution according to the slope of the road and distance between incoming vehicle and subject vehicle.
The first electric headlamp was introduced in 1898 on the Columbia asia car. The concept of moving of the headlamp is actually old one. The old innovation in lighting was vertically tilt the beams introduced in 1917.Horizontal swiveling is also important in automotive industry.AFS is still inaccessible feature for the most of the car on roads today.

New developed AFS is based on image processing. This new kind of AFS system uses image recognition technology to collect the corner information from a certain distance and then it adjust the horizontal movement of the headlamp. To sense the obstacle which comes from front side ultrasonic distance sensor is used according to it vertical movement of headlamp is takes place.

Fig 2: Conventional vs. Adaptive Headlight.

Above fig 2.shows the conventional vs. adaptive headlight system in which it is observed that how better illumination of light get in adaptive headlight system.
The objective to build AFS is modifying the conventional headlamp system considers cost and reliability. It will also increase the comfort and safety of the driver. Another objective is to disassemble the conventional headlight and modify projector light for beam rotation. In order to reduce cost and complexity simple framework is used to develop AFS.

Motivation:-

One of the problems exhibited by existing headlight lies in the fact that the headlight operates only one of the two modes either as high beam or low beam. Because of that in case of curved road or incoming vehicle driver get the unreliable and insufficient view of the road and probability of the accident is increases. Modern headlight system offer the chance to improve the vision of car driver in front of their car in situation which not well served by conventional headlamp system.spetially curved roads, intersections and the far zone of straight roads, highways at higher speed need to be illuminated better by the automatic headlamp. This can be achieved by well designed and tested adaptive front light.

Need:-

The most important and safety functions of vehicle are headlamp. There is large disparity between daytime and night time traffic fatalities. So the light distribution of headlamps should be able to fulfill all needs such as, no glare, sufficient illumination of light to avoid accidents.

In daily life, while using vehicle at night it is a problem of blind spot when turning at corner. Headlamps are parallel to body of vehicle so while turning to left as well as right light illumination is tangential and insufficient for the driver so there is need of adaptive front light system in which vehicle turns left or right at corners of the road

headlight also moves according to turn and one can get better light illumination. By using this adaptive front light system accidents can be avoid up to the 50%.

Methodology:-

A.Proposed Design

Design a system which does rotation of headlight with high sensitivity and processing the output of the sensor using microcontroller and then directing the motors attached to headlight.

Hardware and Software Requirement:-

- PC with MATLAB
- KEIL
- Ultrasonic distance sensor
- ARM Controller
- 5 .Servo motor

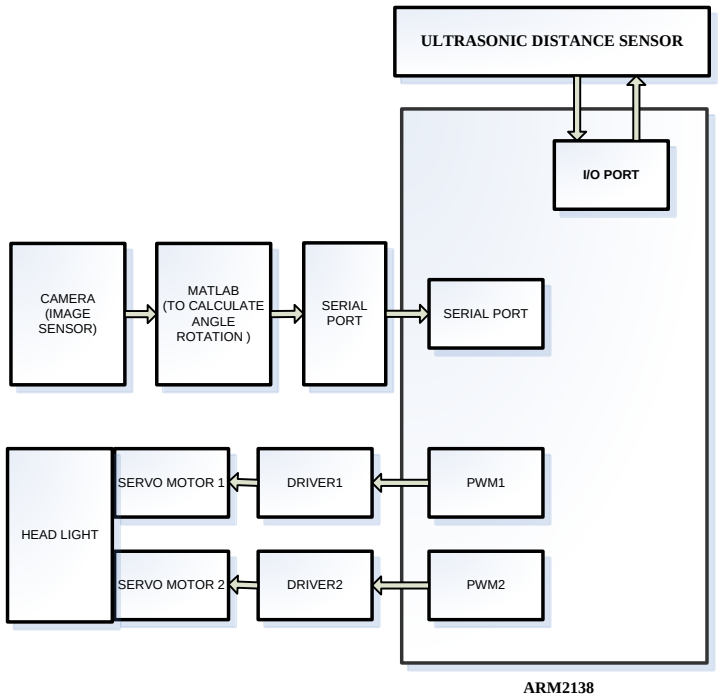

Fig 3: Block diagram of Adaptive Front Light System.

The block diagram of proposed system is shown in figure2. In the system camera is used to detect information about corner.Matlab is used to build mathematical model of this system. Image processing hardware is used as sensor for detecting slope of road.

Principle of Operation:-

Horizontal movement of headlamp:-

Matlab software is used to configure the camera for manual trigger. When the image will be captured matlab code will trigger the camera and obtain live image from camera. This image will go process of operations like preprocessing, colors conversion, segmentation, feature extraction and decision this result that is slope of the road will be send to microcontroller by serial port. After receiving matlab result microcontroller will calibrate the angle and will change the PWM signal fed to servomotor. Camera and horizontal servo motor form sensor actuator loop. Here Hough transform for image processing is used. From Hough transform rotation angle for the turn will be calculated. In this way matlab processing is used in the system for image processing to find angle of road so that vehicle can done adjustment in advance to avoid obstacles.

Servo motor needs PWM pulse of 20ms period, minimum on time of 1ms and maximum on time of 2ms.As per on width of PWM servo motor will have rotation angle mentioned in fig 4.

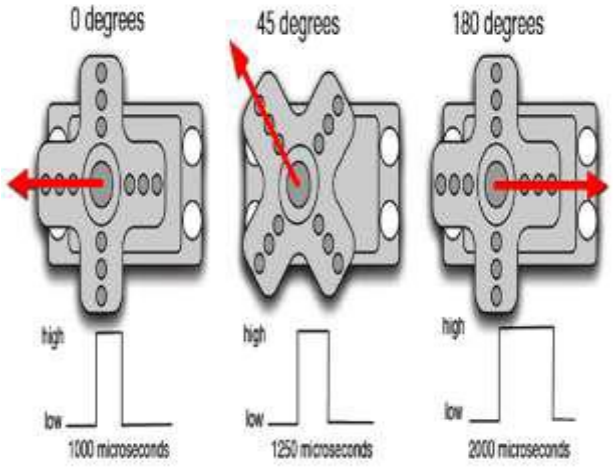

Fig 4.PWM(Pulse Width Modulation)

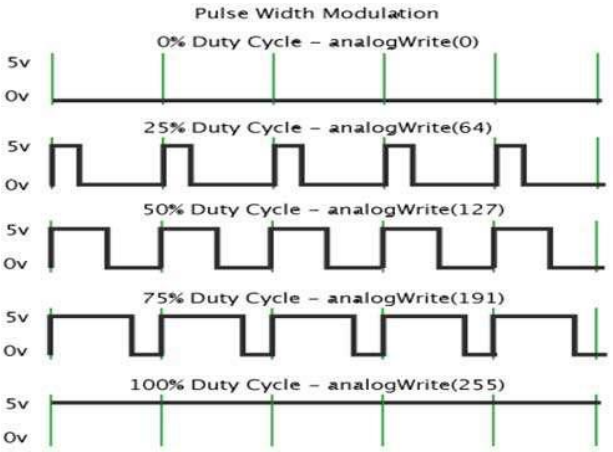

Fig5: PWM Outputs

Fig 5 shows different PWM signals. one is PWM output at 25% duty cycle that is signal is on for 25% and off for 75% similarly next output waveform shows PWM output at 50%,75% and 100% duty cycles respectively. These PWM output encodes three different analog signal values at 10%, 20% and 90% of the full strength.

Vertical movement of the headlamp:-

Ultrasonic distance sensor is used for vertical movement of headlamp. This sensor is work on principle similar to radar and sonar just like measuring instrument that evaluate attribute of a goal by decoding the echoes from radio waves and sound waves severally. It generates high frequency sound waves and evaluates the echo that is received by the device. Sensor calculates fundamental measures between causing the signal and receiving the echo to determine the space to an object. When incoming vehicle is comes in range of ultrasonic sensor it transfers sound waves towards the vehicle. Then upon receiving the eco turn the sound waves in to electric energy which can be measured and transfer to the microcontroller. Then this electric voltage value is given to the PWM of the vertical servo and there is vertical movement of the headlamp is takes place.

vertical_servo_pwm = 18000 + (150 - (ultrasonic_cnt -50))*60

PWM waveform for the vertical servo motor depends upon ultrasonic count. Ultrasonic sensor gives minimum width of 50 and maximum width of 200.Lower limit shifted down to zero by subtracting 50 from all the values Now range is between 0 to 150.To preserve the relation that when object is at far distance headlight angle is up and if object is nearer then headlight should be lowered, obtained count is subtracted from 150.

Components used:-

LPC 2138 an ARM7 series microcontroller is used to control the motor. Motor is used to rotate the headlight mounted above it.There are two types of motor available one is a stepper motor and another one is a servomotor by using these motor we can swing the headlamp but they differ in no of ways. Servomotor requires the analog feedback to control the system. In making choice between stepper motor and servomotor no of issues are considered. It is mainly depend on application which we have to run. Servomotor is more suitable for the AFS design because servomotor have built in feedback circuit.

PWM is nothing but the pulse width modulation.PWM is a technique to controlling analog circuits with processors digital output.PWM is used in wide variety of applications ranging from communication, measurement to power control and conversion.

LPC 2138 ARM7 series microcontroller is used to control the motor.LPC 2138 used 16/32 Bit and has 512KB of internal flash and 32+8K RAM. It has inbuilt 14 channel and 10 bit ADC,6 channel and 10 bit PWM and high speed of 60MHz.Choice of controller is determined by easy availability, affordable price and reliability.

Software flowchart:-

Matlab software allows uploading and execution of the code.Keil tool by ARM (ARM LPC 2138) software is also used.Fig 6.shows software flowchart of proposed system.

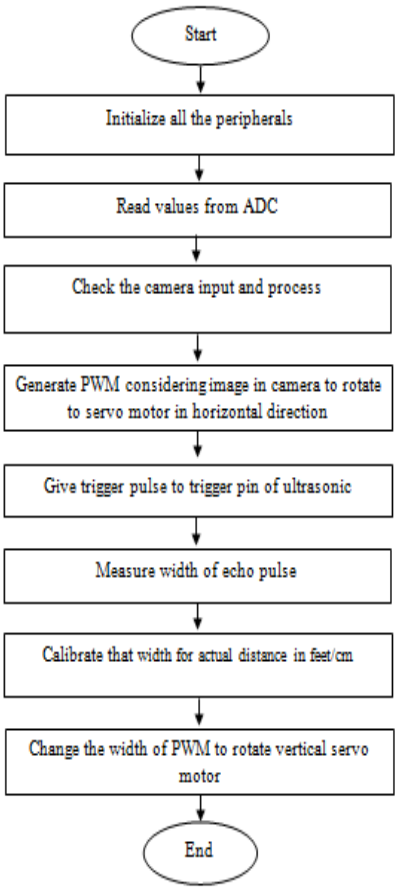

Fig 6. Software flowchart.

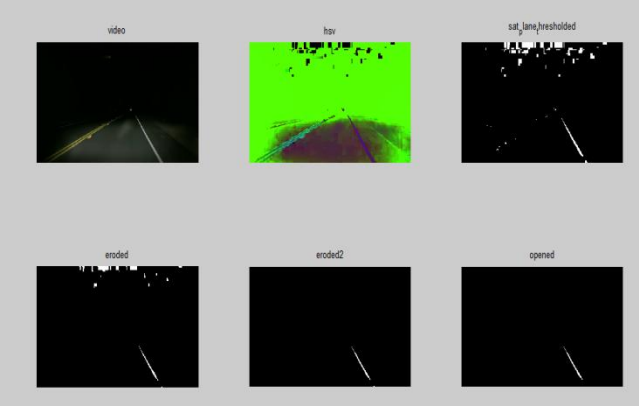

Fig 7.Output when matlabcode calculating slope of the road

Modification in the circuit:-

By referring all the related papers of adaptive front light system but by using image processing in modified adaptive front light system, this proposed AFS is more reliable and high responsive. Camera is used as a sensor for the horizontal movement of the headlamp. It can be modified and used as movable surveillance camera. It can be used for the robotic vision and robotic ARM movement.

Sensor used for the vertical movement of the headlamps is ultrasonic distance sensor which is easily available and affordable. By vertical movement of headlamp driver get the better illumination of light and driver can see the obstacle more clearly.

This AFS system definitely helps to improve road illumination. Because of using image processing will get more range vision in curve compared to traditional AFS.Arrival of this new technology will give opportunities for new suppliers to enter in a market.

Conclusion:-

As discussed above at present existing AFS is not sufficient for driving at night because of disadvantages like lag and precision to avoid this disadvantage the paper put forward an advanced AFS using camera as sensor traditional AFS has greater error in getting curvature radius this new AFS system provides curvature information superior than traditional.

Camera is used to detect real time information of curved road. In this movement of light beam is earlier than turning steering wheel by driver. The AFS system based on image processing proposed. This AFS system has high sensitivity and low cost.

The future work mainly concentrate to invent a comprehensive AFS system which can be suitable for complex road condition including related to the paper. Different conditions can be road surface water, highway, rural road, urban road and so on.

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