

Design and Study of Advance Safety in Automobile using Adaptive Headlight & Automatic Parking Brake

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Abstract- Highest traffic accidents occur during night period on curved roads. The paper provides information of various systems suggested and studied by various authors where efforts are taken to provide light focus/beam of automobile (illumination) in right direction on curved roads. The agenda of systems is to improve visibility of driver, in order to avoid night driving mishaps and improve driving comfort. Various sensors are used such as potentiometer for angle sensing, ultrasonic sensor, camera, image sensor, high resolution spatial light modulator, etc. to send data to control unit. According to this data, further action is taken to actuate adaptive headlight system.

Another topic of this paper is Automatic Parking Brake, which is nothing but one of the braking systems in automobile which provides safety and comfort to driver by eliminating human interference/error in actuation of parking brake. In this review paper, the difference between conventional and automatic brake systems is briefly mentioned along with how such advancement have an edge over the conventional brake system followed by its importance and need. Use of various control units, rear brake actuators, brake button, autohold button, clutch position sender, , Gearbox and Gear mechanism, Infrared sensors, rack & pinion arrangement, microcontroller and relay, cable puller type EPB, etc. have used by various authors for their proposed system.

Keywords- EMPB, Electromechanical parking brake, AHB, driving safety, Adaptive headlight, AFS, Adaptive front light system, steering.

I. INTRODUCTION

Brakes are first important safety systems in automobiles. The use of brakes system are to deceleration, maintain the vehicle's speed and parking. Amongst all this, for parking purpose, handbrake system or parking brake system is mainly used which cause vehicle to be still at any surface. Generally, parking brake system involves the human interference for its actuation. Without hand lever's pull/push, that brake will not work. Also, there is possibility of negligence i.e. in emergency conditions, humans can forget

parking brakes to apply. This can cause vehicle damage. Constant advancements in safety and improvements with respect to the easiness, reliable and comfortable operation of braking systems is today's need. Therefore mechanically actuated parking brakes are being exchanged by advanced systems which gives scope to different ideas and technology in parking brake system. Today, parking brake used are generally three types, mechanically operated (conventional) system, electro-mechanical parking brake (EMPB) system and electric parking brake (EPB) system with every system having its own advantages and limitations. The brief information of this systems along with different new proposed solutions and systems by various authors is mentioned in this review paper. A headlamp is a lamp attached to the front of a vehicle to light the road ahead, while headlight properly is beam of light produced and distributed by the device. Adaptive Head light Mechanism is advancement in conventional system in order to improve driving safety particularly at night and fog time. Various authors proposed solution regarding this, which includes Headlights, Steering Systems, different sensors, control units and actuation mechanisms using cables, links, etc. have briefly mentioned below.

II. LITERATURE REVIEW

The research papers related to present work on Automobile Safety are discussed and what conclusions were incurred are highlighted in this section.

- 1) Rareş CRIŞAN, Olimpiu TĂTAR, Vistrian MĂTIEŞ, Dan MÂNDRU [1] have given information related to driving safety at the time of fog and night. For the same problem they proposed solution which is fully integrated about spot light positioning i.e. didactical stand. Two different principles have presented, one with demonstrative approach using Lab View software and another using microcontroller. At time of night driving, opposite drivers gets disturbed by projected lights on their window. The solution given in two stages in order to improve visibility in curves, first by auto-adjusting headlights and other by direction depending on angle of driver wheels. Constructive solution of light positioning given in two modules, considering trajectory and

considering mass of automobile. It was observed that, using didactical stand, development of cheap solution for positioning of light bulb is possible with construction focusing on programming and electronic design.

- 2) Sumant Ashok Nayak, Kiran G, Kushal P S, Madhu B V and Dr. Ravishankar M K [2] have designed EMPB (Electromechanical parking braking system) by using electric motor, reduction gear train associated with the motor. Lead screw pushes the brake pads which is driven by motor through reduction gear box. They replaced mechanical component by complete electrical component. The EMPB system uses hold and release function to work with ignition conditions of engine. They designed the caliper pot model and made analysis for clamp load of 3700 N by using finite element method. Due to good response time of EMPB system, it becomes possible to apply and release the parking brake in very short time period.
- 3) Ganesh Dhamdhare, Sandhya Chourasia, Sumit Sasatte, Lect. P. K. Warkey [3] have designed and build an adaptive front light control system prototype. This system uses the data of staring angle and rotates the headlamp in horizontal direction. This system uses the data of distance between subject vehicle and next vehicle and rotates the headlamp accordingly in vertical direction. This study mainly concern for vehicle accidents occurring at night. They use POT to sense steering angle. This angle is used to turn the headlamp beam. They used pulse width modulation (PWM) to obtain digital output. Output suggests four positions of PWM with 25%, 50%, 75%, 100% duty cycle. They used potentiometer for angle measurement and ultrasonic sensor to generate echo pulse in response of pulse which is proportional to distance between vehicles.
- 4) Robert Tamburo, Eriko Nurvitadhi, Abhishek Chugh, Mei Chen, Anthony Rowe, Takeo Kanade, Srinivasa G. Narasimhan [4] have initially discussed about the traditional headlights used and how the development took place according to the need. They have specified the need for the programmable automotive headlight. They have explained how flexible headlights can be obtained by introducing high resolution spatial light modulator. This design contains an image sensor which is used to observe the road environment in front and transmit that information to processing unit, which further analyses the image data and controls headlight using spatial light modulator. Spatial light modulator modifies the beam by varying the intensity over space and time in two dimensions. Due to this variation such a beam is created which is suitable to provide a proper view in that environmental condition. Further they explain how their prototype react within 1-2.5 milliseconds to the image sensed by sensor. This prototype takes a lot of space so it's difficult to install in the vehicle hence there is scope to improve its compactness. Further development can be made in reliability against the vibrations and heat in vehicle.
- 5) Chien-Tai Huang, Chien-Tzu Chen, Shou-Yi Cheng, Bo-Ruei Chen and Ming-Hu Huang [5] have explained about use of operation button to replace hand lever in order to have more space in vehicle. Combining a control unit with EPB (Electric Parking Brake) system, simple and right time operation is possible. It is found that using cable puller type EPB with new concept helps to maintain cable life and efficiency. Also, how this system have an edge over conventional system. They studied cable pulling force considering many factors such as balancing, linearity, accuracy and repeatability along with study of actuator's working time.
- 6) Priyanka Dubal, Mr. Nanaware J.D [6] -Highest traffic accidents occur during night period on curved roads. Author provides information of system in which efforts are taken to provide illumination in right direction on curved roads. The aim of system is to improve visibility of driver. Adaptive front lighting system (AFS) provides enhanced safety by earlier detection of information about corner of road by using sensor. Camera is used as a sensor. As per sensor data, adjustments of horizontal rotation of headlamp is done accordingly in order to avoid blind spot while night driving. Future work can be done to improve accuracy and intelligence of sensor used, in order to bear complex road conditions.
- 7) S. Thivagar, C. Nanthakumar [7] have developed an Automatic Hand Brake (AHB) System. They have used Infrared sensors, rack & pinion arrangement, microcontroller and relay in AHB system. They have connected hand brake to the rack & pinion arrangement. Pinion is operated by motor. This motor receives signal from microcontroller and pinion rotates in a direction. The microcontroller sends signal to the motor according to the signal received from IR (Infrared) sensors. Three IR sensors are used. One sensor is used to detect whether wheel is running or at rest. Another sensor is used to detect the position of gear lever and the third sensor is used to detect whether the ignition is in ON or OFF position. According to combination of signals received by sensors, microcontroller is programmed and respective signal is sent to motor and hand brake gets automatically

engaged. They have developed AHB system only for automatically engaging the hand brake. Disengagement of handbrake is done by conventional way of pushing push lock, aided spring tension which helps in quick lowering of handbrake to the floor. Through this system they have achieved improved parking experience on hill & reduced manual interaction.

- 8) Shirsat Shashikant, Mechkul M. A. [8] have developed Adaptive Front Light System (AFS) for automatically regulating the light distribution of a vehicle. Horizontal movement of headlamps is regulated in relation to angle of steering for which potentiometer is used as angle sensor. Vertical movement of headlamps is regulated in relation to distance between subject vehicle and oncoming vehicle for which ultrasonic sensor is used. AFS offers increased safety during night time driving reducing accident risk as compared to conventional headlamps.
- 9) Self-study programme 346, The electromechanical parking brake, Wolfsburg [9] -In this programme initially they have given the difference between conventional and electromechanical brake and how electromechanical have an edge over the conventional brake followed by importance and need of electromechanical parking brake. After giving an overview they have explained all the components separately in details such as ABS control unit, Electromechanical parking brake control unit, Rear brake actuators, Electromechanical parking brake button, AUTOHOLD button, clutch position sender, the rear brake actuators, Gearbox and Gear mechanism. Further they have explained the functions of the electromechanical parking brake such as Parking brake function, Dynamic drive-off assistant, dynamic emergency stop and AUTOHOLD function and how that function can be used while driving the car.
- 10) Mr. Prathamesh Baing & Mr. Shishir Khetale [10] have developed an Alternate Braking System in Case of Brake Failure Situation. During normal working of brakes the brake pedal does not touches the floor of the vehicle. But when brake fails, brake pedal on pressing touches the floor of the vehicle. In this Alternate Braking System, authors have placed a kill switch behind brake pedal on the floor of the vehicle. This kill switch is connected to battery of car, winder motor, parking lights, buzzer & spark ignition system. During brake failure, kill switch gets pressed & four actions take place simultaneously. 1) Winder motor starts running which is connected to a pulley. A cable is wound over pulley & connected to hand brake. Thus on running of winder pulley hand brake is applied. 2) Parking lights are turned on to alert the nearby

vehicles. 3) A buzzer alerts the passenger inside the vehicle. 4) Electric supply to spark ignition system is cut off through a switch operated automatically by the specially designed circuit & engine is turned off. The vehicle is still in ignition mode so the steering of vehicle is in driver's control.

- 11) Amit B. Maske, S.B Tuljapure, P.K Satav [11] have done design, analysis, and fabrication of automatic parking brake system. They have replaced mechanical linkages by electric motor driven units. They used analytical simulation and experimental methods to get results. They also validated obtained results. They designed spur gear, worm gear output shaft and selected proper DC motor. They used CATIA V5 for 3D modelling and ANSYS Workbench for analysis. They successfully implemented this new system in Maruti Suzuki 800 which is a type of small hatchback. Pulling and pushing the lever and apply force to lever gets eliminated due to implementation of this new type of parking brake system. Just pressing On-Off switch parking brake can be applied or released as required by driver. Locking mechanism of system consists of worm and worm gear.

III. CONCLUSION

Today's existing conventional systems do not provide the required solutions regarding safety of driver and automobile. Due to this disadvantage, there is need to understand an alternative technology solution. This review paper provides information on various factors affecting safety in automobile. Use of rack and pinion mechanism, lever mechanism, control unit with a EPB, microcontroller, relay, etc. in Automatic Parking brake System and Spot light positioning with didactical stand, ultrasonic sensor, auto-adjusting headlights, POT to sense steering angle, camera as sensor, etc. in Adaptive Headlight System are briefly mentioned with how such advancement have an edge over conventional systems in order to have advanced safety in automobile.

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REFERENCES

- [1] Rareş CRIŞAN, Olimpiu TĂTAR, Vistrian MĂTIEŞ, Dan MÂNDRU. 'Design of an Adaptive Headlights System for Automobiles'. *Journal Mechanisms and Manipulators*, Vol. 5, Nr. 1, 2006, pp. 45 – 50
- [2] Sumant Ashok Nayak, Kiran G, Kushal P S, Madhu B V and Dr. Ravishankar M. 'Design and Fabrication of Electromechanical Parking Brake System'. *International Journal of Engineering Research & Technology (IJERT)*, ISSN: 2278-0181, www.ijert.org, Vol. 3 Issue 10, October- 2014
- [3] Ganesh Dhamdhere, Sandhya Chourasia, Sumit Sasatte, Lect. P. K. Warkey, 'Adaptive Front Light Control System for Every Vehicle', *International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)*, Volume 4, Issue 4, April 2015
- [4] Robert Tamburo, Eriko Nurvitadhi, Abhishek Chugh, Mei Chen, Anthony Rowe, Takeo Kanade, Srinivasa G. Narasimhan, 'Programmable Automotive Headlights', *European Conference on Computer Vision (ECCV) 2014*, Conference paper DOI: 10.1007/978-3-319-10593-2_49, pp. 750-765
- [5] Chien-Tai. Huang, Chien-Tzu Chen, Shou-Yi Cheng, Bo-Ruei Chen and Ming-Hu Huang, 'Design and Testing of a New Electric Parking Brake Actuator', Paper: 2008-01-2555, Published on 2008-10-12, *SAE Int. J. Passenger Cars- Mechanical system in Automotive Research & Testing Center (ARTC)*, Taiwan. Link-<http://papers.sae.org/2008-01-2555/>
- [6] Priyanka Dubal, Mr. Nanaware J.D, 'Design of Adaptive Headlights for Automobiles', *International Journal on Recent and Innovation Trends in Computing and Communication*, Volume: 3 Issue: 3, ISSN: 2321-8169 1599 – 1603
- [7] S. Thivagar, C. Nanthakumar, 'Automatic Handbrake System', *International Journal of Engineering Research and General Science* Volume 4, Issue 1, January-February, 2016, ISSN 2091-2730
- [8] Shirsat Shashikant, Mechkul M. A., 'Adaptive Front Light System', *IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)* e-ISSN: 2278-2834, p-ISSN: 2278-8735, PP 05-09, www.iosrjournals.org
- [9] Wolfsburg, The electro parking brake-Design and function, Volkswagen AG, Technical status: 03.2005 Volkswagen AG Service Training VK-21. Link-www.volkswagen.net/technik/ssp/ssp/SSP_346.pdf
- [10] Mr. Prathamesh Baing, Mr. Shishir Khetale, Mr. Rajendra Chorage, Mr. Bhushan Ranim, Prof. R. D. Rajopadhye, 'Implementation of Alternative Braking System in Case of Brake Failure Situation', *International Journal of Research in Advent Technology*, Vol.4, No.5, May 2016 E-ISSN: 2321-9637 Available online at www.ijrat.org
- [11] Amit B. Maske, S.B Tuljapure, P.K Satav, 'Design & Analysis of Parking Brake System of Car', *International Journal of Innovative Research in Science, Engineering and Technology*, Vol. 5, Issue 7, July 2016, ISSN(Online) : 2319-8753