# Design and Development of Automatic Emergency Parking Brake System: A Review

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*Abstract* Disclosed herein are an electronic parking brake system and a control method thereof. The electronic parking brake system includes brakes, Electric Magnets to apply braking force to the brakes, a current sensor to sense current of the motor, and an electronic control unit to judge the braking force of the brakes based on the current of the motor, and to control driving of the motor based on the braking force. The electronic parking brake system senses the position of the vehicle using the small-sized proximity sensor, thereby easily obtaining a space in which the current sensor is installed and thus reducing a product size of the electronic parking brake system.

*Keywords: Speed Sensors, Inclination Sensors, ECU, Electro Magnets, Control Circuit, Wheel*

## 1. Introduction

Electronic park brakes started to appear in vehicles from the early 2000s. They've arrived with little fanfare, but there are solid reasons for the global automotive industry adopting the new technology. With this electronic system there is no need for a cumbersome lever fitted in the vehicle cabin, and nor is there any need for a cable mechanism to the rear wheel brake callipers. To actuate the system the driver simply pulls the park brake switch (or presses it down in some cars). This sends a signal to the park brake control unit, which in turn sends a signal to activate the electric motors on the rear brake calipers. These then apply the brake. To release the Park Brake the driver pushes (or pulls) the Park Brake switch and the electric motors are activated to release the rear brake callipers. Parking brakes are not only required to hold the vehicle in a stationary position but can also be used to assist learner drivers and physically disabled individuals. A novice driver while on a slope can use the parking brake for a start assist which will prevent the vehicle from rolling back downwards and preventing damage to other vehicles or putting the lives of pedestrians in danger.

Combining a control unit realizes the intelligent functions, which make vehicles more convenient and secure.

## 2. Literature Survey

Jeremy J. Gill and Michael Slumba [1] et al. An electric brake assembly for tensioning a brake cable and observed that The electric brake assembly wherein the cable attachment is located between the lead screw bore and guide shaft bore such that the brake cable is entirely located between a central axis of the lead screw bore and central axis of the guide shaft bore.Chien-Tai. HuangChien-Tzu Chen [2] et al. have conducted Cable-pulling force.Parking brake force can be maintained when thepower source of electric motor is off.Working time of the actuator.The force for two sides of parking brake is near and observed that a new concept design of the EPB system that has simple and low-cost characteristics. The testing results prove the feasibility. Sandeep Thorat Agampal Singh [3] et al. have conducted disc brake driven by motor and non-Kevlar asbestos brake calipers of a car to reduce the cost of prototype. Solenoid valve is used to bypass the braking circuit to actuate the brakes and observed that We can reduced the Driving Interference of Braking and Give the Responsibility To Intelligence Sensor which will Take decision and initiate the Response To give Warning alarm First and if Distance of impact is Closing it will Apply brake Automatically and Stop the Vehicle in advanced. Amit B. MaskeS.B TuljapureP.K Satav [4] et al. have conducted a combination of electrical and gearing system is used making increasing flexibility and response time of the system. Stress analysis using FEA method in ANSYS. Design of gearing system solid edge and observed that in new designed parking brake system the hand lever is totally eliminatedBraking action will be activated and deactivated only by just pressing ON-OFF switch.Worm n worm gear acts as a locking mechanism for applying brakes. Olivier Chapuis, Lionel Farres [5] et al. have conducted The park brake actuator is electronically controlled, the amount of effort provided by the park brake actuator to the park brake device is controlled through at least one park brake ECU (Electronic Control Unit). The system may comprise an air compressor which can be operated by the engine of the vehicle or by an electric machine and observed that The invention has been described in the context of pneumatic park brake system, but it is understood that it could be applied to any park brake system where an actuator generating the park brake effort can be electronically controlled, such as a park brake system with a hydraulic or electromagnetic actuator which can be controlled electronically. Jong-Gu Son [6] et al. has conducted the rotational force is transferred to the decelerator using the gear assembly by an operation of the motor. Thus, the second planetary gears meshed with the fixed internal gears revolve when the first solar gear is rotated, and the revolution of the second planetary gears is transferred to the second decelerator part through the first carrier and observed that An interval between teeth formed on an inside and an outside of a belt gear that is engaged with a solar gear and a ring gear is selectively increased/decreased so that a required deceleration ratio can be easily provided. Johannes Huennekens Sammuel Ellis Gregory Foletta [7] et al. have conducted

interface configured to enable a user to select one of multiple parking brake modes, a second interface configured to provide a variable parking brake application request and observed that The system wherein the controller is further programmed to, in response to an ignition status being key-off, actuate the parking brake to provide 100% of available braking force.The second interface is a pair of buttons indicating increasing and decreasing parking brake application requests and the controller is further programmed to indicate the amount of braking force via a visual displays-Hwan NO[8] et al. Manual manipulation button provided at the front of the main body. Manual manipulation button is turned on and control the EPB actuator to stop execution of the parking application mode when the manual manipulation button is turned off and observed that Even when a controller to control the EPB actuator has broken down, an EPB system may be operated in a parking application mode, a parking release mode, or a manual manipulation mode in which the EPB system is operated only while a user pushes a switch. Jae Woo Jeon [9] et al. has conducted EPB (Electronic Parking Brake) ECU which controls the EPB drives an EPB motor and a target clamping force by the EPB is generated, and therefore a vehicle is maintained to be stopped and observed that when the transfer of the braking power is generated, a load sensor which has been used to compensate the decrease of the braking power of the parking brake and a circuitry for the load sensor are not needed, and the costs can be saved. Jay Stone Guy Charles Andrew Timothy [10] et al. have conducted Floating caliper design which has a single piston on one side of the disc that presses against the disc when the driver presses the brake pedal and observed that Less expansion under pressure and so provide a more responsive and consistent brake feel, with a shorter pedal travel and better feedback. Choong Sik Shin [11] et al. has conducted a power generating unit a braking force transmission unit a braking force supplementing unit a brake body part which is connected with the braking force transmission unit and parks a vehicle by using the braking force and observed that a braking force transmission unit which is coupled to the power generating unit in a threaded connection manner, rectilinearly moves by the power, and transmits braking force generated by the rectilinear movement. In Yeong CHOE Dong-il Chang [12] et al. have conducted The EPB system includes the ECU which performs overall control related to the applying of an electronic parking brake. An input side of the ECU is electrically connected with a parking switch turned on or off by a driver to operate the parking of a vehicle and a current detector which detects a current flowing through the motorof the EPB actuator and observed that the parking brake is automatically applied or released depending on the control determination of an electronic control unit which simply operates a switch or performs overall control. Tae-Sung Kim Hong-Seok Choi [13] et al. have conducted a gear box assembly which transmits power output from the motor to the final gear and observed that Power transmission is simple and a sensor for detecting a braking force can be mounted by a simple structure. Zhaoyong Liu [14] et al. have conducted Electronic parking brake

system and assistant starting method thereof for a motor vehicle and observed that the electronic parking brake system receives all sensor signals and detection signals of the motor vehicle. When the conditions are satisfied, the brake will be released to assist a driver in starting. Tae Sung Kim [15] et al. have conducted a switch device for an electronic parking brake of a vehicle comprised of a housing an operating lever a switch circuit and a magnetic sensor unit configured to output a surplus driving signal in order to operate and release the electronic parking brake in response to the rotation of the operating lever and observed that The switch circuit and the magnetic sensor unit can be configured to work with each other by another power source. Ho-Jin Choi [16] et al. has conducted a wheel speed sensor, a vertical acceleration sensor, an electronic control unit (ECU) a parking brake. Brake is applied by control signal from the ECU(Electronic control unit) and observed that EPB system detects the rolling and automatically re-clamps the parking brake when the vehicle rolls on the inclined road. Gyung Hun SIM [17] et al. has conducted electronic parking brake system which variably controls the duty of voltage applied to a motor upon release of the electronic parking brake system and observed that The EPB system provides a variety of functions such as, automatic coupling of the parking brake upon emergency braking and engine stop, and anti-slip on an incline. Sang Jun Kim [18] et al. has conducted Electronic parking brake are provided to prevent collision with a preceding vehicle by generating additional target clamping force through inter-operation with an advanced emergency brake system (AEBS) and observed that As a dual brake system is implemented, breaking force is stronger hence more effective in high incline conditions compared to conventional handbrake systems. Ha Min JUNG [19] et al. has conducted Instead of a drum brake, a disc brake has been used for a rear wheel of a vehicle. Thus as a parking brake is provided separately from the disk brake, a DIH (Drum In Hat) parking brake is used and observed that The EPB(Electronic Parking Brake) accurately determine s when to release the brake, without using a position sensor. Jae Park [20] et al. has conducted Electronic control unit (ECU) creates the pattern of the drive signal according to the states of the four switches and monitors the created pattern to determine whether the parking brake switch is in the applied state, the released state or the neutral state and observed that IF the Electronic parking brake system malfunctions, the manipulation state of the parking brake switch is determined and malfunction is indicated by flickering a lamp only when the parking brake switch is in an applied state. Convenience and stability may be provided for a driver, and the electronic parking brake system may satisfy the regulations. Bin Wang [21] et al. has conducted Integration of a sliding mode control (SMC) method with EPB system. Using IEPB system (Integrated Electric Parking Brake) and observed that Through the SMC method, both the precision and robustness of IEPB system are improved apparently. Chavan Akshay Shivaji [22] et al. has conducted Braking force is applied by the electrical motor with the internal worm and worm gear arrangement to hold the lever at specified position.

The motor can be easily started and stopped by breaking circuit and observed that the automatic parking brake system can be easily implemented in all 4 wheeler without any appreciable changes in the existing system of manually operated brakes. Wook Jin Choi [23] et al. has conducted Connection with a manual operation mode and hydraulic electronic control unit (HECU), an engine electronic control unit (ECU), and a traction control unit (TCU) through switch operation and observed that The electronic parking brake system senses the tension of the parking cable using the inexpensive current sensor, thereby reducing manufacturing costs of the electronic parking brake system. Larry Goodman [24] et al. has conducted Intelligent controller receives signals from the control switch and from one or more electrical device in the vehicle and observed that The model relates to vehicle parking brakes and in particular to an electronically actuated parking brake for handicapped drivers and custom applications. Stefan Goss [25]et al. has conducted a travel-optimized method is used to achieve the released state of the parking brake system and observed that Manual handbrake levers can lock up the rear wheels quite easily if you're attempting an emergency stop on anything but dry pavement. EPB mechanisms work with the anti-lock braking system, as the electronics are integrated—and it can even be configured to brake with all four wheels under emergency situations.

## 3. Conclusions:

The development of an electro-magnetic actuation circuit is selected in order to increase the response time and wear of the system.

Also, a common ECU will be used which will control all the components of the EPB Circuit along with other vehicle functions.

## 4. Future Scope:

Technology in today's day is slowly progressing from conventional mechanical systems to electronics.
There is a vast advancement in electronics in the automobile sector. Hence the scope of this concept is very bright as it will have wide applications.

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