A Review on Automatic Handbrake System

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***Abstract*—An automatic hand brake system for a vehicle consists of an electric motor, associated with the motor for motion from the motor to a brake lever, which pushes the brake pads. This project transmitting provides a new concept design of the EMPB (electro mechanical parking brakes) system that has simple and low-cost characteristics. This project deals with designing and fabrication of EMPB system. Electromechanical parking brake system also referred to as brake by-wire, replace conventional parking braking systems with a completely electrical component system. This occurs by replacing conventional linkages with electric motor-driven units. The braking force is generated directly at each wheel by high performance electric motors and auto control, which are controlled by an ECU. The electronic parking brake replaces the conventional handbrake. It is operated by a switch in the center console. The Electromechanical Parking Brake provides the following benefits over the conventional handbrake: Ease of use-the parking brake can be applied fully regardless of the strength of the driver. Safety- the electric parking brake applies automatically when the key is removed from the ignition.**

***Keywords*—Handbrake,micro-controller, electromechanical parking brakes.**

I. INTRODUCTION

We have pleasure in introducing our new project "**AUTOMATIC HAND BRAKE SYSTEM",** which is fully equipped by automatic system. It is a genuine project which is fully equipped and designed for Automobile vehicles. This forms an integral part of best quality. This product underwent strenuous test in our Automobile vehicles and it is good.

In cars, the parking brake, also called hand brake, emergency brake, or e-brake, is a latching brake usually used to keep the vehicle stationary. It is sometimes also used to prevent a vehicle from rolling when the operator needs both feet to operate the clutch and throttle pedals. Automobile hand brakes usually consist of a cable directly connected to the brake mechanism on one end and to a lever or foot pedal at the driver's position. The mechanism is often a hand-operated lever, on the floor on either side of the driver, or a pull handle located below and near the steering wheel column, or a (foot-operated) pedal located far apart from the other pedals.

Although sometimes known as an emergency brake, using it in any emergency where the footbrake is still operational is likely to badly upset the brake balance of the car and vastly increase the likelihood of loss of control of the vehicle, for example by initiating a rear-wheel skid. Additionally, the stopping force provided by using the handbrake is small and would not significantly aid in stopping the vehicle. The parking brake operates mostly on the rear wheels, which have reduced traction while braking but in some cases, parking brake operates on front wheel, as done in most Citroens manufactured since the end of World War II. The hand brake is instead intended for use in case of mechanical failure where the regular footbrake is inoperable or compromised. Modern brake systems are typically very reliable and equipped with dual-circuit hydraulics and low-brake-fluid sensor systems, meaning the handbrake is rarely used to stop a moving vehicle.

Conventional parking brake actuation involves the human interference. Without pulling or pushing the lever, the parking brake will not work. Also, sometimes due to negligence or in emergency conditions, we humans often forget to apply parking brakes. This may lead to rolling of vehicle in case of slopes and collision with other vehicles in parking area. Constant enhancements in active safety and improvements with respect to the reliability and comfort of operation mean that mechanical handbrakes are increasingly being replaced by electromechanical systems.

This gave birth to ideas of electric parking brake techniques. The fundamental function of the electric parking brake (EPB) is to activate and release the parking brake when the vehicle is at a standstill. In first generation of electric parking brake fitted, a switch on the instrument panel replaces the traditional handbrake lever used to operate the mechanical parking brake. This switch utilizes an electronic control unit (ECU) to trigger electromechanical actuators within the wheel brakes or central actuator that operates the rear wheel brake via a Bowden cable.[1] Further, for reducing drivers effort and reminding for application of parking brake, there was a demand for a completely automated parking brake system, which will be fulfilled by the upcoming ideas of mechatronic. This paper is based on the development of one such system, involving the concepts of automobile, mechanical and electronics, known as Electromechanical parking brake.

The most common use for an automobile emergency brake is to keep the vehicle motionless when it is parked, thus the alternative name, parking brake. Car emergency brakes have a ratchet locking mechanism that will keep them engaged until a release button is pressed. On vehicles with automatic transmissions, this is usually used in concern with a parking pawl in the transmission. Automotive safety experts recommend the use of both systems to immobilize a parked car, and the use of both systems is required by law in some jurisdictions, yet many individuals use only the "Park" position on the automatic transmission and not the parking brake. It is similar to manual transmission cars: These are recommended always to be left with the handbrake engaged, in concert with their lowest gear (usually either first or

reverse). The use of both systems is also required by law in some jurisdictions. However, when parking on level ground, many people either only engage the handbrake (gear lever in neutral), or only select a gear (handbrake released).

II. PROCEDURE FOR PAPER SUBMISSION

A. Review Stage:

Chien-Tai. Huang, Chien-Tzu Chen, Electric parking brake (EPB) system provides the roomy space for vehicles compared with traditional handbrake system. Combining a control unit realizes the intelligent functions, which make vehicles more convenient and secure, and avoid the vehicle damage and danger caused by the negligence of drivers. This paper provides a new concept design of the EPB system that has simple and low-cost characteristics. The testing results have proved the feasibility of this design. First we describe the working principle of this new design, and then introduce the arrangement of the testing system, followed by the discussion of experimental data.

Young O. Lee, Choong W. Lee *, In this paper, an Electric Parking Brake (EPB) system is modelled as a state-dependent switched system. The model involves screw friction which varies depending on the operation region. A new nonlinear proportional (P) controller is proposed and its stability is analyzed via Lyapunov and LaSalle's theory. It is shown that the equilibrium point is locally uniform and ultimately bounded.

Yan-Sin Liao, Chien-Tai Huang, Chien-Tzu Chen,
A new design of integrated Electric Parking Brake system, called iEPB and integrated in the brake caliper, is introduced in this paper. It consists of an electrically operated brake unit and a hydraulically pressed unit independently, and uses a special self-locking mechanism instead of a screw device to increase the efficiency and the working speed. With all conventional EPB system's advantages, it also provides a stronger brake performance and a faster reaction time. In this paper, we describe the working principle of this new design at first, and then introduce the arrangement of the testing system, followed by a discussion of experimental data. The testing results prove the feasibility of this design. The conclusion paragraph summarizes the key points about the design of the iEPB system.

Sumant Ashok Nayak*, Kiran GAn electromechanical parking brake system for a vehicle consists of an electric motor, reduction gear train associated with the motor for transmitting motion from the motor to a lead screw, which pushes the brake pads. This project provides a new concept design of the EMPB system that has simple and low-cost characteristics. This paper deals with designing, analysis and fabrication of EMPB system. Electromechanical parking brake system also referred to as brake by-wire, replace conventional parking braking systems with a completely electrical component system. This occurs by replacing conventional linkages with electric motor-driven units. The braking force is generated directly at each wheel by high performance electric motors and gear reduction, which are controlled by an ECU.

The EMPB system is composed of one electro-mechanical actuator integrated into the disc brake caliper and a controller with redundant connections to the power supply, which is controlled inside the vehicle's cabin by a simple rocker switch. EPB is electronically controlled, and features can be designed easily through software giving an enhanced level of freedom for driver comfort- and safety functionality.

B. PROCEDURE FOR PAPER SUBMISSION

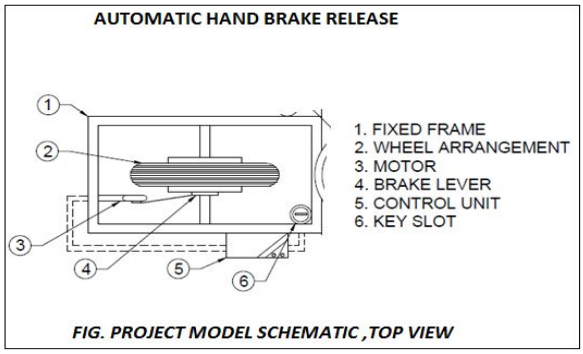


FIG. PROJECT MODEL SCHEMATIC ,TOP VIEW

The major components that are employed in the fabrication of the automatic hand brake release system are as follows.

- Motor,
- Control unit,
- Wheel arrangement,
- Frame,
- Key inserting slot.
- Braking system.

1.Motor-

fig :12 volt geared DC motor

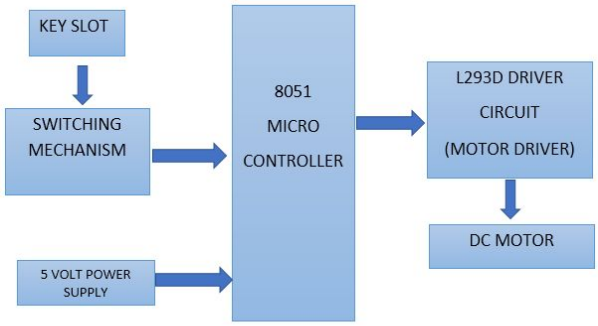
A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. Most types produce rotary motion; a linear motor directly produces force and motion in a straight line.

Specifications of 12 V DC motor:

- Standard nominal voltage = 12 V
- No load speed = 100 rpm
- No load current = 2A
- Nominal speed = 100 rpm

- Nominal torque = 70 Nm.
- Nominal power = 8 watt
- Max power = 70 watt
- Max. efficiency = 80 %

2. Control unit-



AUTOMATIC HAND BRAKE RELEASE ELECTRONIC CONTROL UNIT (ECU)

In automotive electronics, Electronic Control Unit (ECU) is a generic term for any embedded system that controls one or more of the electrical system or subsystems in a motor vehicle.

Types of ECU include Electronic/engine Control Module (ECM), Power train Control Module (PCM), Transmission Control Module (TCM), Brake Control Module (BCM or EBCM), Central Control Module (CCM), Central Timing Module (CTM), General Electronic Module (GEM), Body Control Module (BCM), Suspension Control Module (SCM), control unit, or control module. Taken together, these systems are sometimes referred to as the car's computer. Technically there is no single computer but multiple ones. Sometimes one assembly incorporates several of the individual control modules.

Some modern motor vehicles have up to 80 ECUs. Embedded software in ECUs continues to increase in line count, complexity, and sophistication. Managing the increasing complexity and number of ECUs in a vehicle has become a key challenge for original equipment manufacturers (OEMs).

In our project we use the control unit for controlling the DC motor that activates/deactivates the vehicle braking system. It is very simple in operation that, when the brake lock system is activated from the remote, the control unit switches on the motor and when it is deactivated from the remote, then the control unit reverses the motor direction.

3.Microcontroller-

Fig:Intel P8051 microcontroller.

8051 microcontroller specifications:

- Dual 16-bit address bus – It can access 2 x 216 memory locations – 64 KB (65,536 locations) each of RAM and ROM 128 bytes of on-chip RAM (IRAM)
- 4 KiB of on-chip ROM, with a 16-bit (64 KiB) address space (PMEM). Not included on 803X variants Four 8-bit bi-directional input/output port
- UART (serial port)
- Two 16-bit Counter/timers

4.Wheel Arrangement-

The simple wheel and braking arrangement is fixed to the frame stand. Near the brake drum, the pneumatic cylinder piston is fixed. This wheel arrangement is setup for showing the successful working of our project. But the real implementation can be done in the automobile and the brakes can be applied to all the four wheels.

Fig: Wheel Arrangement

5.Frame:

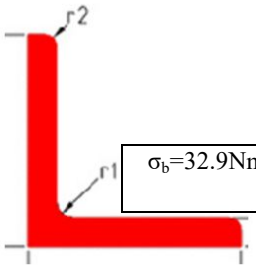
Base Frame Design:

We design a basic frame for a prototype by mild steel channel (L beam),

L Channel- MS Angles are L-shaped structural steel represented by dimension of sides & thickness.

I=125052.08mm4

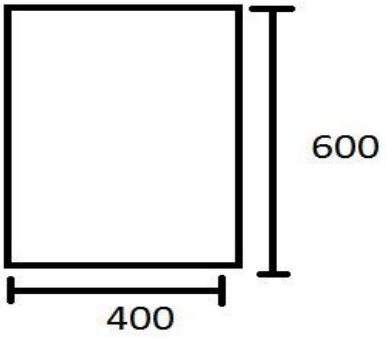
For e.g. 25x25x3 means, both the sides of angles are 25 mm & thickness is of 3 mm. There are various sizes of angles which are as follows :-(there are also equal & unequal angles). Equal angles: - They are angles having both the sides of equal dimensions. For e.g. refer below given diagram, in which both the sides are of dimensions "a".



σ_b=32.9Nmm

Fig. L-angle bar dimensions

By standard available sizes we select the 25 mm so because that will be easily available and have appropriate size for frame.



$$\frac{M}{I} = \frac{\sigma b}{Y} \quad \text{.....s. (1)}$$

Bending moment (M) =force *perpendicular distance

=40*600*

Bending moment (M) =235440Nmm

$$I=\frac{b(h^3)}{12}$$

$$=\frac{35(35^3)}{12}$$

- Therefore above value use in equation no(1).

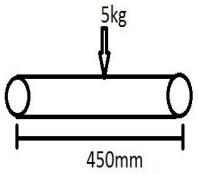
$$\frac{235440}{125052.08} =$$

Therefore,

32.9<105

Hence design is safe.

Design Of Shaft:



$$\frac{M}{I} = \frac{\sigma b}{Y} \quad \text{.....(1)}$$

- Bending moment =force*perpendicular distance =5*9.81

Bending moment=22072.5Nmm

For diameter 15mm,

$$I=\frac{\pi}{64}*d^4$$

$$=\frac{\pi}{64}*15^4$$

=2483.78

Therefore ,

$$\frac{22072.5}{2483.78} = \frac{\sigma b}{7.5}$$

σ_b=8.86*7.5

=66.64

therefore, design is safe.

III. ADVANTAGES:

1) Free from wear adjustment.
2) Reduce the manual work
3) Less skill technicians is sufficient to operate.
4) Installation is simplified very much.
5) Low cost
6) Improves parking experience in hills
7) Very compact.
8) Emergency stop and start is possible.
9) Sensing can be easily done using sensors.

IV. DISADVANTAGES

1. Addition cost is required to install this system to four wheeler .
2. Cylinder stroke length is constant.

5.Working model:

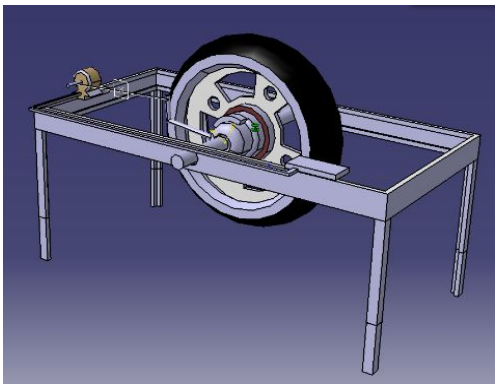


Fig: Model Of Project

V. CONCLUSION

The automatic hand braking system i.e. electromechanical parking brake help with automatic parking brake application based on engine ignition condition. This provide safe braking is assured in slopes and hill starts with the help of "HOLD" function. This system has complete automatic operation for easy drivability and safety. This system also gets some advanced options like hold function in head to head traffic and inclined roads, which would promise the drivers and vehicle owners with a safe pleasure drive and stops. The response time of EMPB system is good. Hence, applies and releases the parking brake in very short time period.

The EMPB system has greater relative advantages over the conventional parking system and will find maximum application in the future because of its significance.

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between the institution and the industries.

VI. ACKNOWLEDGMENT

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