

Design and Development of Hand Brake Release System

Rohan E. Dalvi

UG Student

*Department of Mechanical Engineering
SRTTC, Khamshet, Pune-410405*

Ramesh G. Sutar

UG Student

*Department of Mechanical Engineering
SRTTC, Khamshet, Pune-410405*

Prashant H. Karke

UG Student

*Department of Mechanical Engineering
SRTTC, Khamshet, Pune-410405*

Jitendra B. Satpute

Assistant Professor

*Department of Mechanical Engineering
SRTTC, Khamshet, Pune-410405*

Abstract

An automatic brake system for a vehicle consists of an electric motor, related to the motor for transmission motion from the motor to a brake lever that pushes the restraint. This project provides a brand new idea style of the EMPB (electro mechanical parking brakes) system that has straightforward and cheap characteristics. This project deals with coming up with and fabrication of EMPB system. Mechanical device hand brake system conjointly remarked as brake by-wire, replace typical parking braking systems with a totally electrical part system. This happens by replacement typical linkages with electrical motor-driven units. The braking force is generated directly at every wheel by high performance electrical motors and automobile management, that area unit controlled by an ECU. The electronic hand brake replaces the traditional handbrake. It's operated by a switch within the center console. The mechanical device hand brake provides the subsequent edges over the traditional handbrake: easy use-the hand brake is applied totally no matter the strength of the driving force. Safety- the electrical hand brake applies mechanically once the key is off from the ignition.

Keywords- Auto Hand Brake Release, DC Motor, Relay, Drum Brake, Arduino Microcontroller etc

I. INTRODUCTION

In cars, the parking brake, additionally known as emergency brake, hand brake, or e-brake, is a latching brake sometimes used to keep the vehicle stationary. It's generally additionally accustomed prevent a vehicle from rolling once the operator desires each feet to work the clutch and throttle pedals. Automobile hand brakes sometimes contains a cable directly connected to the brake mechanism on one finish and to a lever or pedal at the driver's position. The mechanism is usually a non-automatic lever (hence the emergency brake name), on the ground on either aspect of the motive force, or a pull handle situated below and close to the wheel column, or a (foot-operated) pedal situated way with the exception of the opposite pedals.

Although generally called a hand brake, using it in any emergency wherever the footbrake continues to be operational is probably going to badly upset the brake balance of the automotive and immensely increase the probability of loss of management of the vehicle, for instance by initiating a rear-wheel skid. To boot, the stopping force provided by using the handbrake is tiny and wouldn't considerably aid in stopping the vehicle. The hand brake operates totally on the rear wheels that have reduced traction whereas braking however in some cases, hand brake operates on front wheel, as wiped out most Citroens manufactured since the tip of World War II. The emergency brake is instead supposed to be used just in case of mechanical failure wherever the regular footbrake is inoperable or compromised. Trendy brake systems square measure usually terribly reliable and equipped with dual-circuit hydraulics and low-brake-fluid sensing element systems, which means the handbrake is never accustomed stop a moving vehicle.

Conventional hand brake feat involves the human interference. While not pull or pushing the lever, the hand brake won't work. Also, generally as a result of negligence or in emergency conditions, we have a tendency to humans usually forget to use parking brakes. This could result in rolling of auto just in case of slopes and collision with different vehicles in park. Constant enhancements in active safety and enhancements with relation to the dependableness and luxury of operation mean that mechanical handbrakes are progressively being replaced by mechanical device systems.

This gave birth to concepts of electrical hand brake techniques. The elemental operate of the electrical hand brake (EPB) is to activate and unharness the hand brake once the vehicle is at a standstill. In 1st generation of electrical hand brake fitted, activate the control board replaces the standard handbrake lever accustomed operate the mechanical hand brake. This switch utilizes associate degree electronic management unit (ECU) to trigger mechanical device mechanisms among the wheel brakes or central actuator that operates the rear wheel brake via a Bowden cable. [1] Any, for reducing driver's effort and reminding for application of hand brake, there was a requirement for a very machine-controlled hand brake system, which can be consummated by the future

concepts of mechatronics. This paper is predicated on the event of 1 such system, involving the ideas of automobile, mechanical and natural philosophy, called mechanical device hand brake.

A. Principles of Operation

“AUTOMATIC hand brake RELEASE” is nothing however one in every of the braking systems in automobile at the time of auto turn off condition. During this braking system motorized operated one. During this project, the management unit is received the signal from the key switch. The key switch is ‘ON’ at the time of auto begin condition. The primary time clutch is applied so the motor is rotating in forward direction for two sec to unharness the brake (Already wheel is on braking condition). The key switch is ‘OFF’ the motor is rotating in reward direction for two sec to applying the brake. “AUTOMATIC emergency brake RELEASE” is nothing however one in every of the braking systems in automobile at the time of auto switches off condition. During this braking system motorized operated one.

II. LITERATURE REVIEW

Design And Fabrication of electromechanical parking brake System [1]

Sumant Ashok Nayak*, Kiran G*, Kushal P S*, Madhu B V* and Dr. Ravishankar M K

An electromechanical brake system for a vehicle consists of an electrical motor, geartrain train related to the motor for sending motion from the motor to a lead screw that pushes the restraint. This project provides a brand new idea style of the EMPB system that has easy and cheap characteristics. This paper deals with planning, analysis and fabrication of EMPB system. Mechanical device brake system additionally observed as brake by-wire, replace typical parking braking systems with a very electrical part system. This happens by commutation typical linkages with electrical motor-driven units. The braking force is generated directly at every wheel by high performance electrical motors and equipment reduction, that square measure controlled by an ECU.

Design and testing of a new electrical parking brake actuator [2]

Chien-Tai. Huang, Chien-Tzu chen, Shou-Yi Cheng, Bo-Ruei chen and Ming-Hu Huang

Electric parking brake (EPB) system provides the spacious area for vehicles compared with ancient handbrake system. Combining an impact unit realizes the intelligent functions, that build vehicles additional convenient and secure, and avoid the vehicle harm and danger caused by the negligence of drivers. This paper provides a brand new idea style of the EPB system that has easy and cheap characteristics. The testing results have proved the feasibility of this style. 1st we have a tendency to describe the working rule of this new style, and so introduce the arrangement of the testing system, followed by the discussion of experimental knowledge.

Slide Mode control for integrated electric parking brake System [3]

BinWang, 1 Xuexun Guo, 1 Chengcai Zhang, 1 Zhe Xiong, 1 Huan Xia, 1 and Jie Zhang2

The rising integrated electrical brake (IEPB) system is introduced and studied. Through analyzing the varied operating stages, the stages switched IEPB system models square measure given with the thought of the friction and system idle inertia. The sliding mode management (SMC) methodology is adopted to regulate the clamping force by the wide used motor angle and clamping force relationship methodology. Supported the characteristics of the state equations, two sliding surfaces are engineered to regulate the motor angle and current, severally. And in each operating stage, the management stability is warranted by selecting the management parameters supported Lyapunov theory and SMC reachability. The effectiveness of the planned system has been valid in Matlab/Simulink.

Novel design of the integrated electric parking brake system [4]

Yan-Sin liao, Chien-Tai Huang, Chien-Tzu chen, Shou-Yi Cheng, Bo-Ruei chen and Fu-Yen Huang

Automotive research & Testing Center (ARTC).

A new style of integrated electric parking brake system, known as iEPB and integrated within the brake caliper, is introduced during this paper. It consists of AN electrically operated brake unit and a hydraulically ironed unit severally, and uses a special automatic mechanism rather than a screw device to extend the potency and the operating speed. With all typical EPB system’s benefits, it additionally provides a stronger brake performance and a quicker latency. During this paper, we have a tendency to describe the working rule of this new design initially, and so introduce the arrangement of the testing system, followed by a discussion of experimental knowledge. The testing results prove the feasibility of this design. The conclusion paragraph summarizes the key points concerning the design of the iEPB system.

III. SYSTEM ARCHITECTURE

The construction of automatic hand brake release consists a base frame created from L angle mild steel. The cross section of L angle is 25*25*3 millimeter. The L angle soft-cast steel square measure welded to make an oblong frame. On this frame a mild steel shaft is welded that is connected with a motorbike wheel. The motorbike wheel encompasses a drum brakes placed at center that is activated by pulling brake lever connected to it. This brake lever is connected to the twelve V DC motor via linkages. The DC motor is of twelve V and one hundred rate. The facility offer to the DC motor is given through a relay that switches its rotations. The relay is controlled by a microcontroller in operation on five V DC offer. That receives input from a key switch that we tend to on or off to realize participating or disengaging of brake via DC motor. The whole system is hopped-up by 12 V lead acid battery.

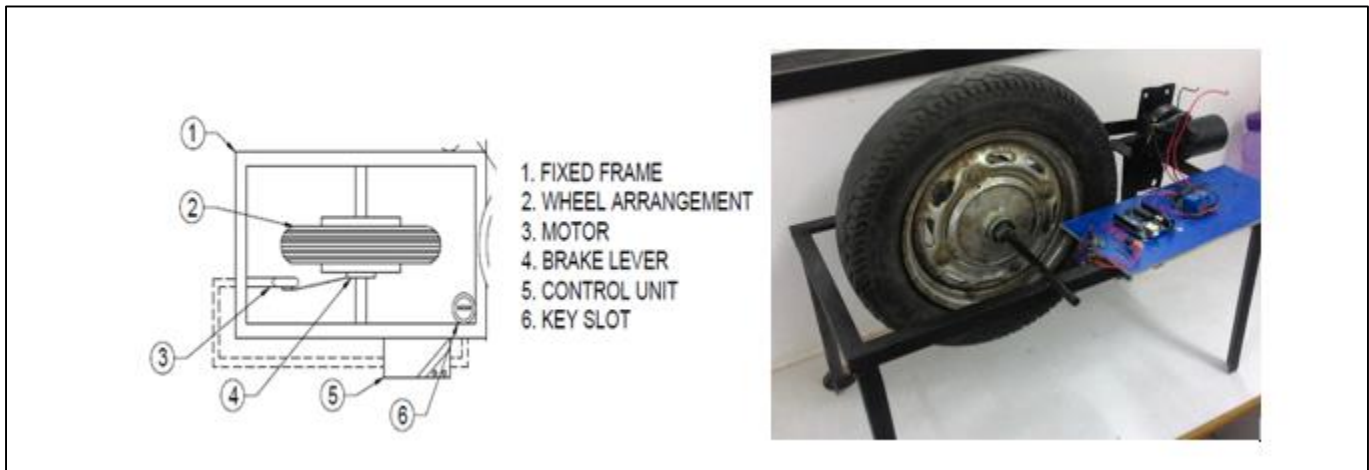


Fig. 1: system architecture (left) and final model (right)

A. Circuit Design

As microcontroller is usually furnished 5V DC and sends the causative signal of vary 0V to 5V to relay supported the ignition condition of engine. Relay is furnished 12V DC and switches the motor to rotate either clockwise or anticlockwise. Because the motor rotates, it produces some electrical noises and high voltage. Thus to stop microcontroller elements from harm because of this noise and high voltage, we tend to are mistreatment opto-coupler in between microcontroller and relay board.

IV. SYSTEM DESIGN

A. Frame

WE design a basic frame for a prototype by steel channel (L beam), L Channel- MS Angles are formed structural steel pictured by dimension of sides & thickness. For e.g. 25x25x3 suggests that, each the perimeters of angles area unit 25 mm & thickness is of 3 mm. There are various sizes of angles that are as follows :- (there are equal & unequal angles).

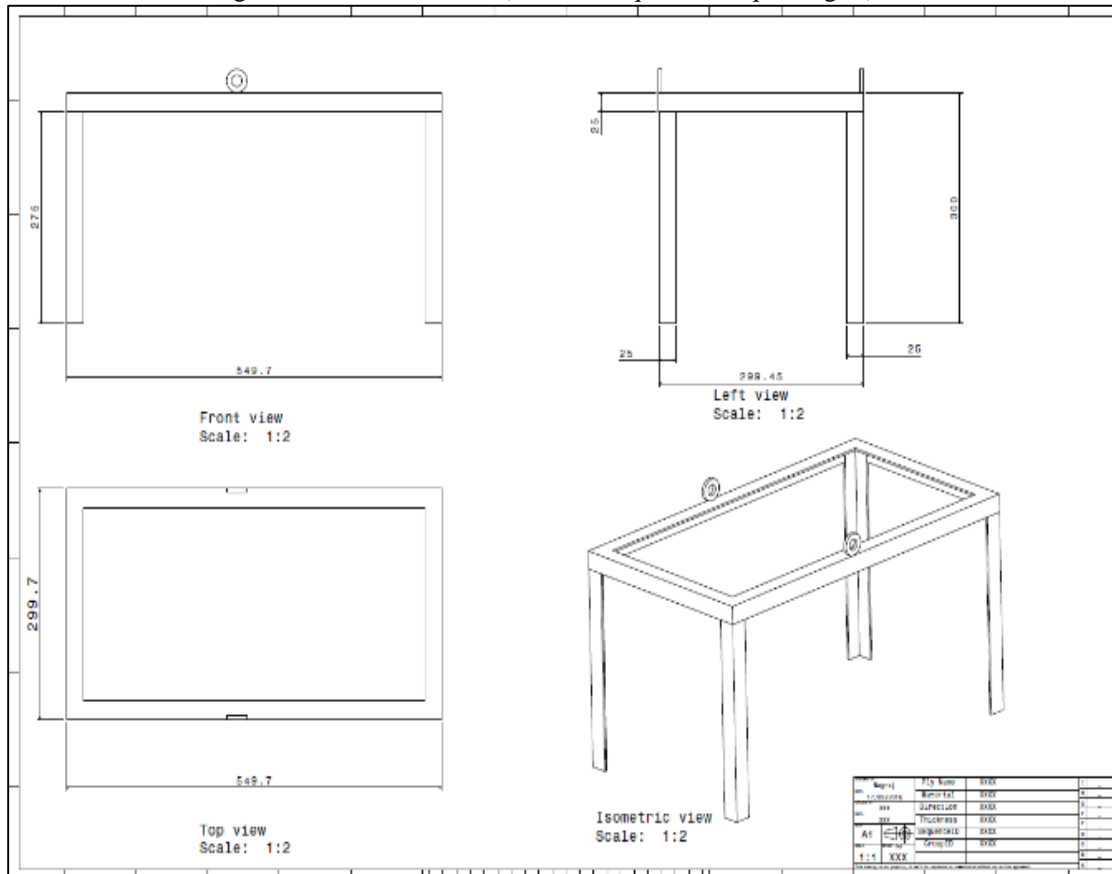


Fig. 2: Frame with Dimensions in mm

B. DC Motor

Type – 12 volt geared DC motor:

A DC motor is any of a category of electrical machines that converts electricity wattage into mechanical power. The foremost common varieties have confidence the forces made by magnetic fields.



Fig. 3: 12 volt, 100 rpm geared DC motor

C. Arduino Uno Microcontroller

Arduino is AN open-source physical computing platform supported a straightforward I/O board and a development setting that implements the Processing/Wiring language. Arduino is accustomed develop complete interactive objects or is connected to software system on your laptop (e.g. Flash, Processing, MaxMSP). The ASCII text file IDE is downloaded for gratis (currently for waterproof OS X, Windows, and Linux).

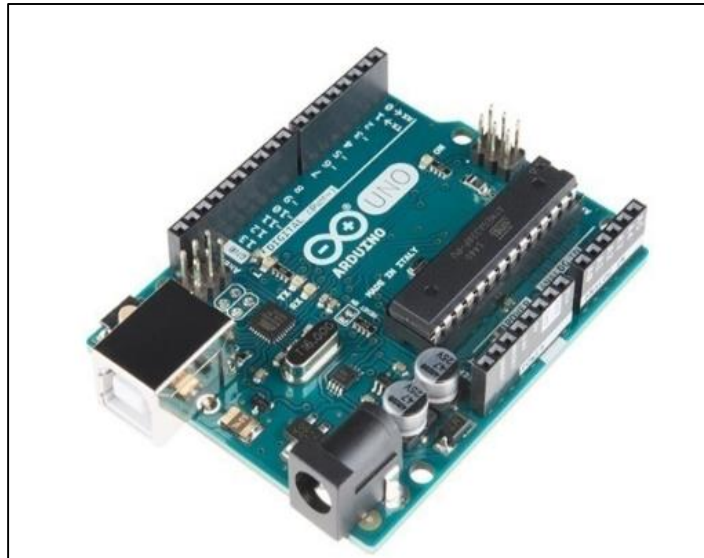


Fig. 4: ARDUINO UNO microcontroller

1) Features

Microcontroller: ATmega328

Operating Voltage: 5V

Input Voltage (recommended): 7-12V

Input Voltage (limits): 6-20V

Digital I/O Pins: fourteen (of that 6 give PWM output)

D. Torque Required by Motor to Brake the Wheel

The torque required to tilt the solar panel with frame structure is as follows:

Total mass of wheel = 4 kg (consider structural mild steel system)

WHEEL OUTER DIAMETER = 400 mm = 0.4 m

Angular velocity of tilting is 100 rpm = 100/60 rps

Amount of Torque required to apply brakes is:

$$T = Mgr \sin \theta + I \alpha$$

Where,

Mg=weight of the tilting mechanism.

I = Moment of Inertia $I = mk^2$,

α = angular acceleration of the tilting mechanism

To calculate torque required for braking and force required for that we need to find above values

Radius of gyration:

For rectangular object the radius of gyration can be obtained as,

$$k^2 = 1/3((D/2)^2)$$

Where D is diameter of wheel in m

$$D = 400 \text{ mm} = 0.4 \text{ m}$$

$$\text{So, } k^2 = 1/3((D/2)^2) = 1/3((0.4/2)^2) = 0.1154 \text{ m} = 115 \text{ mm.}$$

To calculate I (inertia of the tilting mechanism)

$$I = mk^2 = 4 * 0.1152 = 0.0529 \text{ kg.m}^2$$

In two dimensions the angular velocity ω is given by

$$\omega = 2\pi N$$

The angular acceleration is

$$\alpha = \text{angular velocity} / \text{time}$$

$$= \omega / t = 2\pi N / t$$

For one t = minute = 60 sec.

$$= 2 * 3.142 * 100 / 60 * 60 = 1.74 \text{ rad/sec}$$

On substituting the values in equation 1, we get,

$$T = Mgr \sin \theta + I \alpha$$

$$T = (4 * 9.81 * 0.2 * \sin 90) + (0.0529 * 1.74) = 38.84 \text{ N-m}$$

3. Amount of Force required for braking:

$$T = F r$$

$$38.84 = F * 0.2$$

$$F = 194.24 \text{ N}$$

V. CONCLUSIONS

The automatic hand braking system i.e. mechanical device brake facilitate with automatic brake application supported engine ignition condition. This may give safe braking is assured in slopes and hill starts with the assistance of "HOLD" perform. The operating of project is as per expected because the brake is applied by shift off the key and brake is free once key's on. This may reduce human efforts and human errors whereas parking or beginning the vehicle. This technique has complete automatic operation for straightforward drivability and safety. This system additionally gets some advanced choices like hold perform in head to go traffic and inclined roads, which might promise the drivers and vehicle owners with a secure pleasure drive and stops. The system has bigger relative blessings over the traditional parking system and can realize most application within the future as a result of its significance. The system is a smaller amount pricey and more practical therefore are often tailored to any vehicle.

ACKNOWLEDGMENT

Authors want to acknowledge Principal, Head of department and guide of their project for all the support and help rendered. To express profound feeling of appreciation to their regarded guardians for giving the motivation required to the finishing of this paper.

REFERENCES

- [1] Nayak, Sumant. "Design and fabrication of electromechanical parking brake system." (2014).
- [2] Huang, Chien-Tai, et al. "Design and testing of a new electric parking brake actuator." SAE International Journal of Passenger Cars-Mechanical Systems 1.2008-01-2555 (2008): 1217-1222.
- [3] Wang, Bin, et al. "Slide mode control for integrated electric parking brake system." MATHEMATICAL PROBLEMS IN ENGINEERING (2013).
- [4] Liao, Yan-Sin, Chien-Tai Huang, Chien-Tzu Chen, Shou-Yi Cheng, Bo-Ruei Chen, and Fu-Yen Huang. "Novel Design of the Integrated Electric Parking Brake System." No. 2010-01-1707. SAE Technical Paper, 2010.
- [5] Lee Y O, Wongoo Lee, Lee C W, Novel clamping force control for electric parking brake systems, Published in Asian Control Conference, 2009.
- [6] Tatsuya Yamasaki, Masaaki Eguchi, Yusuke Makino, NTN technical review No.75(2007), Need of an Electromechanical Brake, Link- www.ntn-snr.com/portal/fr/en/file.../NTN_TR75_en_P0531.pdf