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Citation: AIP Conference Proceedings **1952**, 020014 (2018); doi: 10.1063/1.5031976
View online: https://doi.org/10.1063/1.5031976
View Table of Contents: http://aip.scitation.org/toc/apc/1952/1
Published by the American Institute of Physics

Anti-Lock Braking System (ABS) and Regenerative Braking System (RBS) in Hybrid Electric Vehicle for Smart Transportation System

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Abstract. Pulse width modulation (PWM) based (a non-consistent) breaking system is used to keep the wheels from being bolted in the proposed antilock breaking system (ABS). Using this method a better hold of the street by wheels is possible and halting separations likewise diminish essentially particularly on precarious street surfaces like frosty or wet streets. The active vitality of the wheel is by and large lost amid braking as warmth because of grinding among brake cushions. This vitality can be recuperated using regenerative braking systems (RBS). In this strategy, the overabundance vitality is put away incidentally in capacitor banks before it gets changed over to warm vitality and is squandered. This framework delays the battery life by reviving the battery utilizing the put away vitality. Subsequently the mileage of the electric vehicle likewise increments as it can travel more separation in a solitary battery charge. These two techniques together help make electric vehicle vitality productive and more secure and less demanding to utilize subsequently anticipating and diminishing the quantity of mischance's.

Key Words: *PWM, Braking, ABS, RBS, Regenerative Braking*

INTRODUCTION

General Structure of an Electric Vehicle

There are many blessings of working electric vehicles. first, there's no gasoline smell as the automobiles operate on batteries, now not on gas, diesel, or a few other type of flammable gas. Electric powered cars are quiet...the journey is actually silent. With the aid of efficiently the use of regenerative braking, electric powered cars acquire extra brake lifestyles as well as create power through kinetic strength. via the use of high-tech composite technology, electric cars may be a great deal lighter than an ice counterpart which also facilitates lessen brake put on together with street put on. Electric powered automobiles are a great deal greater power efficient. Electric powered cars convert without a doubt all of their fuel electricity into usable strength. The internal combustion engine (ice) is much less than 20% green. Renovation value, such as gasoline fee, is much lower with an electric car way of putting off everything on a vehicle protection checklist that relates to the ice, it turns into a pretty quick list and by way of charging at night time, the "gasoline" for electric powered automobiles is reduced up to 1-fourth the price of gas or diesel.

International Conference on Electrical, Electronics, Materials and Applied Science
AIP Conf. Proc. 1952, 020014-1–020014-6; https://doi.org/10.1063/1.5031976
Published by AIP Publishing. 978-0-7354-1647-5/$30.00

LITERATURE REVIEW

Khatun et al. executed an exploratory test for setting up the antilock braking system (ABS) for electrical vehicles. The PM engine is associated with a three stage acceptance engine which is utilized to recreate genuine street stack. Reproduction contemplates are utilized to infer an underlying principle construct that is then tried with respect to a test setup speaking to the elements of a stopping mechanism. Fluffy rationale participation capacities are depicted for parameters like slip and watched stack torque. Dixon and Ortuzar depicts a strategy to recuperate vitality amid braking by utilizing an arrangement of Buck-Boost converter and Ultracapacitor bank [2]. IGBTs are used to make Buck-Boot converters on a Chevrolet electric truck. Various plots were used to conclude with parameters such as battery current, voltage and back voltage of the capacitor. Later Xiufang and Xin experimented to quickening of the wheel is measured and plotted. At the point when the quickening is negative, i.e. deceleration is occurring; the rationale continues observing the incentive till it is of lower esteem. A technique for substitute lift weight and decompress is utilized so that the vehicle can remain in the steady district for whatever length of time that conceivable and the ideal braking weight can be connected [6].

DESIGN & IMPLEMENTATION

Brake Systems in an Electric Vehicle

Stopping mechanisms in electric powered automobiles may be of diverse sorts. in some vehicles, normal grating brakes are utilized. in such frameworks, continual braking is attached which produces touch and prevents the wheels from pivoting, therefore backing off the car. In such stopping mechanisms, the brake cushions heat up and this activates energy wastage as warmth. Every other sort of stopping mechanism is the anti-lock brake device. Right here, nonstop braking is not related. Rather, a non-persistent braking design is hooked up which moderates or stops the vehicle as required. This kind of framework is more efficient than the conventional stopping mechanism and gives an unmatched execution. Another sort of stopping mechanism is the regenerative slowing mechanism. In any such framework, the engine itself or few other circuits try to apply brakes by controlling the modern engine circuit.

Anti-Lock Braking System

Stopping automation is one of the slowing mechanisms utilized as a part of electric vehicles which can supplant the customary contact stopping mechanism by utilizing a non-persistent braking design by mulling over elements like vehicle speed, deceleration, street conditions and so on. ABS gives a better braking execution as thought about than regular grinding braking and furthermore spares vitality. Hard braking do not happen in ABS due to which the issue of wheel bolt up arises which also know to be as antilock system. However the issues related with directional bolt up are settled in ABS, so that it gives a directional control at a consistent level to a driver at the time of braking. On the other hand, ABS works at low slip locale so that wheels are having more footing along with the surface of the street and this in turn does not allow the wheel bolt up. In cutting edge frameworks, numerous sensors recognize the wheel speed exclusively and microcontrollers understand whether a wheel is going to bolt up.

Regeneration in Electric Vehicles

A battery gives vitality to the electric engine to run. At the time of braking, the dynamic vitality of the engine is changed over into warm vitality because of grating in the brake cushions and is in this manner lost. Regenerative Braking is a vitality recuperation framework which tries to recoup this vitality before it is changed over into warm. This vitality can be put away incidentally or can be utilized promptly. Such a braking is finished by using engine as a generator. At the time of braking engine give back vitality to the battery for charging. On the other hand, the current heading off to the electric engine while braking will be redirected and put away. This charge will be offered to the battery whenever required. Such impermanent stockpiling can be expert by using the flywheel setup or by using a capacitor bank.

ANALAYSIS RESULTS

Experimental set up

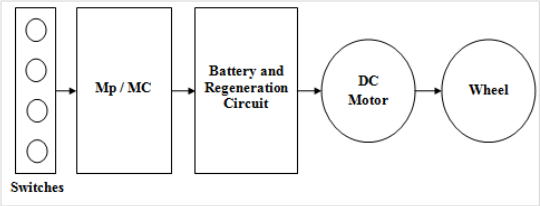

FIGURE 1: Experimental set up

Antilock braking and regeneration is attempted for all intents and purposes making use of the trial check circuit. This circuit has a sixteen bit at 89C51 microcontroller P.C., pace microcontroller with four ports each of 8 bits, unique propelled clocks, serial and parallel correspondence conventions and so on. This unit is utilized to get and ship symptoms to the circuit. The percentage of lead-corrosive battery is a gift offering additional power to the circuit. The experiment used a high rpm gearless dc engine through an engine driver IC. The engine motive force IC offers maximum glide to use with the engine and it is associated with a little wheel (which is also considered as a mild load) for the purpose of gives up the goal for testing. The engine depends on the way of pole defined for the wheel setup which has a breaking device that is controlled by using microcontroller signals [10]. A regeneration circuit consists of a battery and capacitor bank circuits associated with IGBT buck-boost converter, which is an introduced modification to control the flow of current in the capacitor bank.

Pulse Width Modulation (PWM) Circuit

The PWM circuit elude the switches on port side of microcontroller and PWM braking signals are provided using the yield port pins of the test circuit. The three switches as shown in Figure 2 provide the variable velocity for the engine and these switches will help to improve the agent pedal of the car. Such modifications of the pins on the port are designed as statistics port to produce low, medium and high speeds to imitate the squeezing of quickening agent. Each revolutionary switch helps to change the engine speed and to run the DC engine the PWM wave is supplied to port e yield stick which later passed to the IC of engine motive force. Specific obligation cycle esteem is supplied to individual switches and these cycles are modified by varying incentive inside the application of the arm controller. The three switches consumes 25% (i.e. 1/2) of widespread obligation cycle esteems and 75% of duty cycle of PWM wave selects ordinary voltage of DC engine to control the pace of the hard braking in an automobile [8].

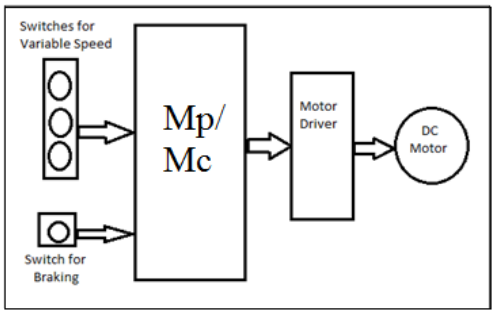

FIGURE 2: PWM Circuit

With the help of large wheels bolted up, the automobile slides slightly when it is braked suddenly from a fast moving car. By squeezing the switch microcontroller applies a PWM braking signal to the engine until the engine is definitely ceased, that means the electric automobile is completely conveyed to cease. However in the case of PWM braking, the braking signal will not hold ceaselessly as compared to normal braking systems. A controlled duty cycle of square wave is given due to braking sign. During the ON time of the pulse wave braking sign is excessive so that the wheels are braked. However at the OFF time of the pulse wave, braking sign goes lows and hence the brakes will

get discharged. In such scenario the wheels will pivot and adjustments in bearings of wheels can be accomplished which is not possible at the time of regular braking methods. Also make a note that during the ON time, subsequent cycle of PWM flag brakes are once again linked in the same manner and such practice of discharging the brakes will be completed in short speeds which results to the brakes on the wheels at a frequency of 15 Hz. This allows the tires to preserve on the floor by retaining slip esteem low, and within intervening time to maintain a bit ceasing separation. Such a breaking system maintains possible strategic distance from trouble trigger limits that are observed in braking without bargaining safety and braking adequacy of the car. Whereas in case of PWM braking it ensures the engine is ceased quickly without locking and without bargaining the capability for modifying the path of the wheels due to tough braking. A DC motor is used to realize variable paces and to break the layout flag.

The Regeneration Circuit

Regeneration circuit accommodates the energy required to the circuit from the battery, which is a lead-acid battery with ostensible voltage of 12 V and restricts to a power limit of 1.3 A-h [2, 9]. A capacitor bank stores the energy by which a large squandered amid braking as warm temperature power. Capacitors related to this circuit are connected in parallel so that the combination will increase the overall capacitive energy. The aggregate energy available inside the capacitor is based on the overall capacitance and the voltage of the capacitor bank [9, 10]. The battery pack and capacitor financial institutions are linked with IGBT greenback-enhance converter. The Inductor (L) will be huge with a value of 10mH and Ls will be of the range of 1 µH. The value of capacitor (C) in the below circuit will of 470 µF and the combined capacitance of the capacitor financial bank will be equal to 7.6 mF. The overall value of the voltage across all capacitances will be equal to 35 V. The resonance circuit undergo with two operations includes greenback operation and enhance operation [10]. The first operation takes place when the deceleration of vehicle takes place due to the application of brakes. That means it happens inside the circuit by means of squeezing the braking transfer. The enhancement operation takes place when the electric vehicle speed in increasing from lower velocity, i.e. at the time of quickening of the vehicle using the revolutionary speed switches.

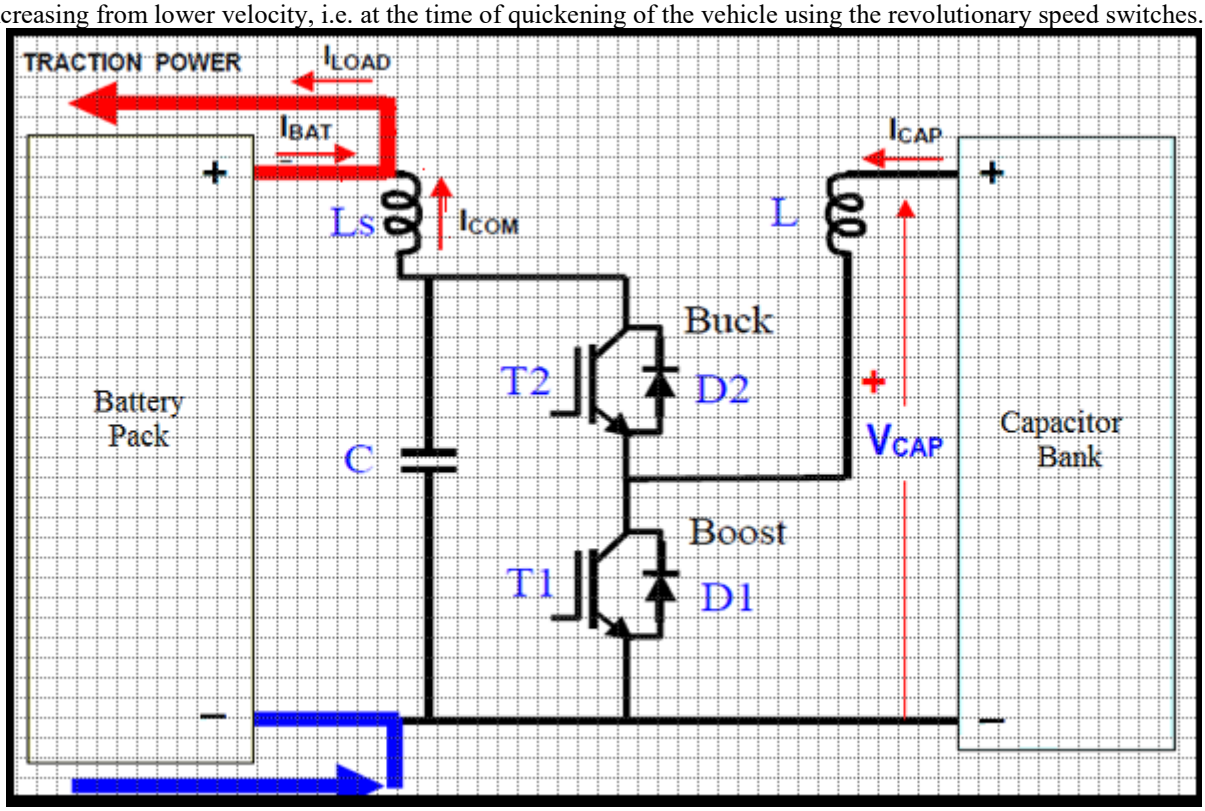

FIGURE 3: Regeneration Circuit

In the case of buck operation converter occupies present setting of the engine of the battery to the capacitor financial institution. This operation is controlled by using PWM movement on IGBT T2. For the condition, when T2

is ON, vitality goes to capacitor bank from the battery PC through T2 and inductor (L) stores this energy. On the other hand when T2 is OFF, inductor (L) attempts to proceed with modern and the relaxation of the energy positioned away in L will be exchanged in the capacitor bank through the way finished through the diode D1. For the buck operation obligation cycle of PWM flag given to IGBT T2 is by way of and large 75%.

Amid the increase operation (quickening), IGBT t1 is grew to become on and off at a managed responsibility cycle, to alternate the specified measure of energy to the battery percent from the capacitor. Amid quickening, maximum power is needed to provide more energy to the engine and this extra energy is given to the battery from the capacitor bank. The duty cycle given to the IGBT T1 is round 25%. Amid this operation, the capacitor financial institution does no longer void out its whole rate. this relies on upon the degree of current that can move till the IGBT t1 is worked. at the off chance that any rate is still left within the capacitor bank, it's miles put away as it's far and is applied amid the subsequent boost cycle to restore the vitality back to the battery. in available applications, if tremendous capacitors are applied, at that factor the execution of the circuit is opened up because of the standard execution of first rate capacitors. exquisite capacitors can charge and release significantly faster than ordinary capacitors. likewise their energize limit is to twenty instances that of trendy capacitor. the value of superb capacitors or extremely capacitors is higher however on account that of their foremost execution, they may be applied as a part of such circuits for regenerative braking.

Simulation of Regenerative Circuit

The recreation of this recovery circuit is made using Matlab-Simulink. The estimations of all segments are set as portrayed previously. The reproduction charts are obtained using a CRO to calculate the battery voltage, current, capacitor bank voltage and current and finally the PWM flag given to drive the IGBT. Yield is appeared for the 3 cycles of PWM signals, which is later given to the IGBT.

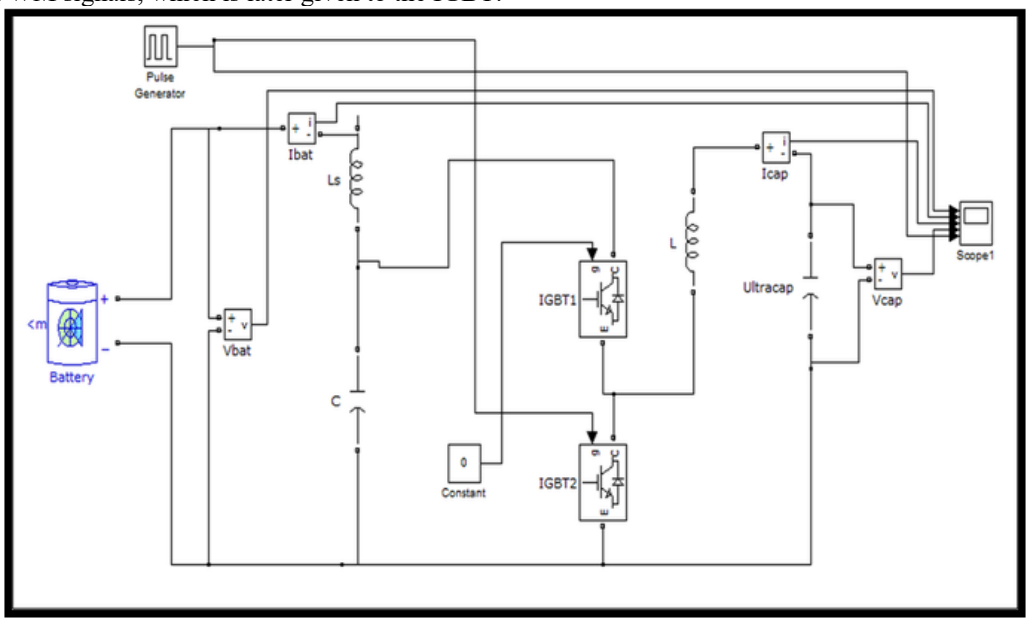

FIGURE 4: Simulation model of regenerative circuit

During the buck operation it is observed that the capacitor bank voltage continues to increase along with the revolutionary cycles. The underlying price display in the capacitor financial institution is 0 henceforth the voltage over the capacitor financial institution is also zero in the beginning. Then the voltage crosswise over it at that point continues expand from 0 to 11 V close to the finish of the 0.33 cycle. The PWM signal is given to power the IGBTs is ready at 60% responsibility cycle. It is observed that the battery voltage without a doubt is found to be constant around 12 V stamp with moderate changes. Current from battery facet is drawn in the direction of the capacitor financial institution just amid the on time of the beat given to IGBT and is normally zero. The contemporary via the capacitor financial institution increment amid the ON time of PWM wave and declines a chunk of amid the off time.

CONCLUSIONS

The regenerative circuit stores and returns the power again to the battery that would have been typically squandered. The dollar-help converter is based on upon indicators from the microcontroller and works step by step in order that the vitality may be placed away at the best photograph of deceleration and can be lower back again amid the couple of moments of dashing up. The capacitor bank excessively prices and releases short in order that the vitality circulation may be quick and powerful without tons misfortune. This makes a battery closing longer and additionally allows an electric powered vehicle to travel encourage on a solitary battery price i.e. the mileage of the electrical vehicle increments generously. Recovery alongside anti-lock braking gadget makes an electric vehicle power powerful and further more at ease and less stressful to utilize and ends up being an imperative part in the quality feasible working of an electric powered car [10]. The capacitor bank may be supplanted by ultra capacitors whilst the framework takes a shot at a better voltage degree. Ultra capacitors are luxurious yet the can store 20 times the vitality put away in traditional capacitors and feature drastically much less vitality misfortune. The ultra capacitors whilst applied as a part of a actual electric vehicle which might be working around a 300volt dc battery deliver emerge as being financially savvy and further equipped for giving a conventional execution.

ACKNOWLEDGMENTS

The scholar are grateful to Professor G. Srinivasa Rao, Dept. of EEE, Vignan University, Vadlamudi, Guntur, A.P, for giving his valuable time to improve the quality of paper.

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