Design And Analysis Of Regenerative Braking System And Automatic Braking Using Ultrasonic Sensor

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Abstract- *The main aim of this project is to generate electrical energy from vehicle braking system. A regenerative brake is an energy recovery mechanism which slows a vehicle by converting its kinetic energy into another form, which can be either used immediately or stored until needed. This contrasts with conventional braking systems, where the excess kinetic energy is converted to heat by friction in the brake linings and therefore wasted .The most common form of regenerative brake involves using an electric motor as an electric generator. In electric railways the generated electricity is fed back into the supply system, whereas in battery electric and hybrid electric vehicles, the energy is stored in a battery or bank of capacitors for later use. Energy may also be stored mechanically via pneumatics, hydraulics or the kinetic energy of a rotating flywheel. This rotation of flywheel is used to store the electrical energy to battery by using Permanent magnet D.C generator.*

Keywords- Braking, Ultrasonic sensor,IR sensor, Power generation.

I. INTRODUCTION

Man has needed and used energy at an increasing rate for its sustenance and well being ever since he came on the earth a few million years ago. Primitive man required energy primarily in the form of food. He derived this by eating plants or animals, which he hunted. Subsequently he discovered fire and his energy needs increased as he started to make use of wood and other bio mass to supply the energy needs for cooking as well as agriculture. He added a new dimension to the use of energy by domesticating and training animals to work for him.Energy harvesting has been a topic of discussion and research since three decades. With the ever increasing and demanding energy needs, unearthing and exploiting more and more energy sources has become a need of the day. Energy harvesting is the process by which energy is derived from external sources and utilized to drive the machines directly, or the energy is captured and stored for future use.

Stopping distance consist of three factors:

- ✓ Driver's reaction time.
- ✓ Brake pedal.
- ✓ Braking distance.

1. REGENERATIVE BRAKING:

Regenerative braking is an energy recovery mechanism that slows down a moving vehicle or object converting its kinetic energy into a form that can be either used immediately or stored until needed. In this mechanism, the electric traction motor uses the vehicle's momentum to recover energy that would otherwise be lost to the brake discs as heat. This contrasts with conventional braking systems, where the excess kinetic energy is converted to unwanted and wasted heat due to friction in the brakes, or with dynamic brakes, where the energy is recovered by using electric motors as generators but is immediately dissipated as heat in resistors. In addition to improving the overall efficiency of the vehicle, regeneration can significantly extend the life of the braking system as the mechanical parts will not wear out very quickly.

1.REGENERATIVE BRAKING USING ELECTRIC MOTOR:

Electric vehicles and Hybrid vehicles use electric motor as a source to propel themselves. As known, when motor is made to run in reverse direction it behaves as a generator. Similar concept or principle is utilized for regenerative braking. When braking has to be done, motor switches to generator mode. The generator captures the kinetic energy of wheel via drive train. Thus, it transforms the kinetic energy into electrical energy which is stored in a battery for further use .On the other hand, generator resistance produced from the electricity created, slows the vehicle. The bigger the power of Motor/Generator in generator mode, the larger amount of kinetic energy would be recuperated. The capacity of battery to store the energy is also a factor that affects the amount of energy recovered. When the torque generated by the generator is less as compared to the required braking torque, it is supplemented by friction brake.

2. SMART BRAKING SYSTEM:

Smart braking system is designed for preventing lots of accidents. It operates automatically not manually so chances of failure of this system is less due to this the chances of accident is also reduces. It is a electro-mechanical device which is designed to prevent accidents and loss of human lives. This system contains ultrasonic, relay switch, micro controller unit, actuator and brakes.

3.ULTRASONIC SENSOR:

Ultrasonic sensing is one of the best ways to sense proximity and detect levels with high reliability. An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns.

4.IR SENSOR:

IR Sensor module has great adaptive capability of the ambient light, having a pair of infrared transmitter and the receiver tube, the infrared emitting tube to emit a certain frequency, encounters an obstacle detection direction (reflecting surface), infrared reflected back to the receiver tube receiving, after a comparator circuit processing, the green LED lights up, while the signal output will output digital signal (a low-level signal), through the potentiometer knob to adjust the detection distance, the effective distance range 2 ~ 10cm working voltage of 3.3V-5V. The detection range of the sensor can be adjusted by the potentiometer, with little interference, easy to assemble, easy to use features, can be widely used robot obstacle avoidance, obstacle avoidance car assembly line count and black-andwhite line tracking and many other occasions.

II. LITERATURE SURVEY

Manjukumari,shambhukumar,anandkumar,nikitakumari, on "Intelligient braking system using ultrasonic sensor" November 2020 observed. An intelligent mechatronic system includes an ultrasonic wave emitter provided on the front portion of a vehicle producing and emitting ultrasonic waves frontward in a predetermined distance. An ultrasonic receiver is also placed on the front portion of the vehicle operatively receiving a reflective ultrasonic wave signal. The reflected wave gives the information of presence of the object. After that its stop and move backward and detect obstacle in other direction and move forward in direction when it didn't detect any object without crashing with the obstacle. The microcontroller is used to control the brakingof the vehicle based on the detected pulse information to automatically stop the vehicle. A mechatronic braking system discussed in this paper is developed and designed in such a way that, when it is active it can apply break automatically encountered by any object sensed by the ultrasonic sensor. Intelligent braking is one of the smartoption in which can be initiative in various automobile applications for stopping a moving body without spasmodic motion. Design of intelligent brake applications basically depend upon effectiveness of ultrasonic sensor and microcontroller and controlling the speed of vehicle according to programmed distance is revealed in the study done by our team.

S.harshavarthini, M.divya, rahulbongarla, C.haripriya, R.balaji on "a critical investigation on regenerative braking energy recovering system on HEV based on electric and natural extracted fuel" December 2020 observed. In recent years the process of developing hybrid electric vehicle with a regenerative braking system is been thought by the manufacturers and the usage of HEV is been eventually increased. Regenerative braking is a mechanism that helps to slow down the moving electric vehicle. By this slow-down process, the kinetic is been converted into electrical energy, and this converted energy can be either stored or used immediately. The regenerative braking system involves various benefits. Proper implementation of the regenerative braking system extends the driving range, improvers the braking efficiency,reduce brake wearand also improves the energy. Due to the recharging capability of the battery during travel, it is determined that regenerative brakes have innovative features. It also results in less thermalconductivity and balance the tribological factor so that the regenerative brakeslast longer than non-regenerative brakes. The regenerative braking system is almost used in all of the hybrid and battery charged electric cars. The fuels which is been used in the vehicles are natural gas and biodiesel. Biodiesel is been obtain by the extraction of a few natural products which helps in the movement of the vehicle. A hybrid vehicle runs on a twin powered engine which helps in conserving the amount of energy. Hybrid electric vehicle is eco-friendly and it has abetter gas mileage performance. This research is a detailed study of future development of highly efficient with low pollution HEV.

Sailendra sigh, Yogesh jangid, sahilgupta, Virendra solanki, on "smart braking system using ultrasonic sensor and actuator" June 2019 observed. The number of automobile users is increasing day byday .
At the same time, traffic congestion has become a worldwide problem. This problem is mainly due to human driving which

involve reaction time delay and judgment error that may affect traffic flow and cause accidents. Road-accident is most unwanted thing that happens to road user. In scenarionormally, vehicle equipped with ABS, traction control, brake assists etc. For driver's safety. All thesesystem employ different types of sensor to monitoring the condition of the vehicle and respond in an emergency situation. This smart braking system has to be work with ABS equipped in vehicle in order to increase vehicle stability during emergency braking.the primary objective of this paper is to develop a safety car braking using ultrasonic sensor and to design a system with less human attention to the driving. The braking system, if implemented can reduce number of accident and can save invaluable human lives and property the whole system is widely open and can work with various brakes, various sensor and actuator solution. It must be mentioned that the different subsystem such as sensors, actuators etc. Have found other application since they were designed. Now, this system is designed as a project work at small level but we can adopted this system at industry level so that we can prevent lots of accident and human lives. The future of automotive safety is more than just developing new technology for preventing accidents.

A.aravinthkumar,R.kumar,ajitharulDaniel,A.parthiba non "ultrasonicbraking using smart sensoring system" December 2018 observed. While we have a tendency to square measure traveling within the vehicle we should always management the break if any object forthcoming people. For that, we've got designed this project for automatic braking system. Whenever we have a tendency to management the break, at the time what happens within the system suggests that one amongst the coil winding is placed around it. It generates the emf and it's fitted with the appropriate mechanical set. After we unleash the brake the force generate in is stopped and also the coil winding release from the mechanical set. The entire report offers a short discuss of "ultrasonic sensing element distance controller". Several benefits square measure there in comparison to alternative braking system. The planned system supported ATMEL microcontroller is found to be a lot of compact, user friendly and fewer advanced, which might promptly be employed in order to perform many complex tasks. Though it's designed keeping in mind regarding the necessity for business, it will extended for alternative function like business applications. Because of the chance of engineering used this "ultrasonic device control" system is totally package controlled with less hardware circuit. This feature makes that this technique can be the platform for future systems.

III. WORKING PRINCIPLE

Break drum set up is set fixed to the frame stand and it will rotate by manually with the help of two end bearings. Scissor type breaking pedal is fixed to the break drum by using Mild steel plates. Two generators with wheels are fixed to the scissor type arrangement such as by pressing brake pedal which is touches the break drum. By applying break two generator wheels are rotating and power is generated and it's stored in a battery. For displaying the effective working, a LED is connected with the generator. Therefore if a brake pedal is presses, the generator generated power and the LED glows. The LED can be replaced by a battery for storing of the generated electrical energy.

a. Working of Regenerative Braking System:

The electric motor drives the wheels, either in conjunction with the gasoline engine as in a hybrid, or on its own in a battery-electric vehicle. As you drive forward, the motor runs in that direction, supplying electric power to the wheels. But when you decelerate by taking your foot off the throttle, the electric motor stops supplying power so the vehicle will slow down. When the motor stops, it immediately disengages, and then starts running backwards. The transmission is still in Drive, so it doesn't reverse the wheels; instead, it acts like a generator. It captures the kinetic energy from the wheels as they slow down, and converts it into electricity. It's then stored in the battery, to be sent back to the electric motor when it's needed to drive the vehicle's wheels.

b. Working of Ultrasonic Sensor:

Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensors, like many others, use a single transducer to send a pulse and to receive the echo. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse.The working principle of this module is simple. It sends an ultrasonic pulse out at 40 kHz which travels through the air and if there is an obstacle or object, it will bounce back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated.Ultrasonic sensors are a great solution for the detection of clear objects. For liquid level measurement, applications that use infrared sensors, for instance, struggle with this particular use case because of target translucence.For presence detection, ultrasonic sensors detect objects regardless of the colour, surface, or material (unless the material is very soft like wool, as it would absorb sound.) To detect

transparent and other items where optical technologies may fail, ultrasonic sensors are a reliable choice.

c. Working of IR Sensor:

When the module detects obstacles in front of the signal, the circuit board green indicator light level, while the OUT port continuous output low-level signals, the module detects a distance of 2 ~ 10cm, detection angle 35 °, the detection distance can be potential adjustment with adjustment potentiometer clockwise, the increase in detection distance; counter clockwise adjustment potentiometer, the detection distance decreased.The sensor active infrared reflection detection, target reflectivity and shape of the detection distance of the key. The black minimum detection range, white maximum; small area object distance is small, a large area from the large.

IV. ADVANTAGES

- An efficient alternative energy harvesting system.
- The power generated by this method can be used for car battery.
- The cost of the project is less.
- Maintenance free system.
- It is one of the unconventional, non-polluting forms of energy harvesting methods.

V. DISADVANTAGES

- Power Production time is less.

VI. RESULTS TABLE

After the successful testing, the model is operated and there volts obtained in various loading condition are noted and tabulated below.

Fig. vi. Result table

S.N	RPM before brake pedal pressed	RPM after brake pedal pressed	Voltage output
1	500	480	9.34
2	550	520	10.88
3	570	530	11.81
4	700	670	12.91
5	770	740	13.49
6	850	820	13.89
7	1020	990	14.49

It can be seen from there volt tables that the efficiency of the regenerative braking systems using D.C Motors increases as the angular velocity of the motor increases and hence the regenerative braking systems are more efficient as higher angular velocities and the recoverable energy increases with increase in the motor speed. The losses are higher at lower speed because the motors are inefficient at lower speeds, whereas the losses at higher speeds are mainly mechanical losses like friction losses and air drag.

VII. DISCUSSION

With the markets for hybrid, electric and highly efficient, low emission conventionally- powered vehicles set to grow rapidly, the pace of development of regenerative braking systems looks similarly set to increase. The two key barriers to the market for battery- electric vehicles (BEVs)are currently their high cost (particularly of the battery packs) and limited range. For system developers, future challenges will include reducing costs, increasing vehicle range and meeting stricter safety and emissions standards. The braking regulation will need to be applied to advanced systems that not only stop the vehicle but recover lost braking energy. Insummary the analysis suggests that current, “first-generation” regenerative braking systems do not compromise braking safety. The tests carried out on one such system, fitted to a hybrid vehicle, did not raise any safety issues. The primary determinean to flow powerful the regenerative braking system might be the power capacity of the battery or other energy storage device/system, that is its ability to quickly convert the kinetic energy of the vehicle into its stored form.Basic mechanical engineering theory suggests for current systems, which can only operate at quite low power levels (< 30KW, say), the regenerative braking component is likely to be quite small, particularly at high speeds. Such systems thus need a substantial additional source of braking torque for medium-high deceleration stops from such speeds, i.e. a conventional friction-braking system.

VIII. CONCLUSION

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.We are proud that we have completed the work with the limited time successfully. The “FABRICATION OF POWER GENERATION FROM REGENERATIVE BRAKING SYSTEM” system is working with satisfactory conditions. We can able to understand the difficulties in maintaining the tolerances and also the quality. We have done to our ability and skill making maximum use of available facilities. Thus we have developed a “POWER GENERATION FROM REGENERATIVE BRAKING

SYSTEM" which helps to generate power from the speed breakers using rollers and generators. Also we gathered knowledge about the energy harvesting methods and the simple mechanisms associated with it. By using more techniques, they can be modified and developed according to the applications.

IX. AUTHORBIOGRAPHY

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