Automatic Brake Failure Detection with Auxilary Braking System

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Abstract-*Now a day, Machines are widely controlled by control system. To meet the need of exploding population economic and effective control of machines is necessary. The aim is to design and develop a control system based an electronically controlled automatic break failure indicator by using IR Sensor. Automatic break failure indicator and auxiliary braking system is consists of IR sensor circuit, control unit and frame. The sensor is used to detect the break wire, the control signal to the alarm unit. Similarly the auxiliary brake is fixed to the wheel frame and this can apply the brake and stop the vehicle. A pressure transducer sensor monitors the pressure in brake lining. When the primary hydraulic disc brake fails, the sensor detects the pressure loss and gives warning signal to the driver and also Activates power supply to the secondary braking unit which is a hub motors in rear wheels . This functions as a secondary braking unit and helps the driver to stop the vehicle and thus ensures safety of the passengers.*

I. INTRODUCTION

Today accidents are occur due to lot of reasons, the one of the main reason is brake failure, it caused to due to poor maintenance as well as product defect, in order to safe guard the valuable human for accident the accident monitoring of brake is very important thing in automobile Vehicle safety is the avoidance of automobile accidents or the minimization of harmful effects of accidents, in particular as pertaining to human life and health. Special safety features have been built into vehicles occupants only, and some for the safety of others. We have pleasure in introducing our new project "Automatic Brake Failure Indicator with auxiliary braking system". This is equipped by sensors and auxiliary braking unit. It is genuine project which is fully equipped and designed for automobile vehicles. This forms an integral part of best quality. This product underwent test in our automobile vehicles and it is good. A brake is a mechanical device that inhibits motion by slowing down a body or by slowing it. Brakes retard the motion of a body creating friction between two working surfaces and converts the kinetic energy of the moving body in to heat. Brakes are generally applied to moving as well as tyres. Sometimes brake failure may occur when the brake lining is cut-off.

And the brake fluid leaks out causing pressure loss and hence the brake shoes does not apply the required pressure on the discs. The pressure loss can be detected by a pressure sensor. Pressure sensor functions as a transducer. Transducers produce electric signals as output. The output from the pressure transducer goes to the comparator. The comparator has a reference value of the pressure. The electric signals generated by the pressure transducer are a function of the pressure. The Comparator compares the pressure value with the reference value. If the value is different from the Reference value, the value is sent to relay. A relay is an electrically operated switch .Relays is used to control a circuit by a low power unit with isolation from control circuit as well as the controlled circuit. The relay receives the electric signals from the comparator. The relay is connected to battery at one end and auxiliary braking unit at the other end. The relay connects the power source to the auxiliary Braking unit.

II. AUXILARY BRAKING UNIT

The auxiliary braking unit is used as secondary braking unit when the primary hydraulic disc brake of the vehicle fails. The secondary brakes receive power from battery. The secondary braking unit is a hub motor unit present at both the wheels of the rear axle. The hub motor also called as wheel hub drive is an electric motor incorporated into the wheels of the vehicle. Hub motors have their highest torque when they start. When the relay receives positive value from comparator, it connects the power source to the hub motor .The hub motor rotates in a direction opposite to the direction of rotation of the wheels. Therefore the hub motor provides negative torque to the wheels and retards the output power of the wheels. Thus the wheels are slowed down and the vehicle is stopped .Figure 1 represents the creo model of primary and auxiliary braking system

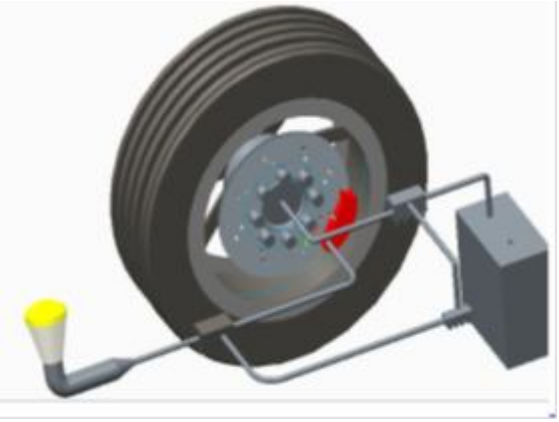

Figure-1

III. LIST OF COMPONENTS

- 12V Battery Differential Pressure transducer
- IC 741
- JK flip-flop IC 7474
- Electrostatic relay
- Differential Pressure transducer
- ½ HP Hub motor

IV. WORKING OF THE SETUP

In this Project we are using control unit to check the Brake condition. Here we are sending the signal voltage through the Brake Wire from one end to other end. which is shown in fig.2 At the other end in the wheel the signal conditioning unit checks that whether the signal voltage in the Brake wire is available or not.

If the Brake Wire is in the good condition the signal and conditioning unit check that in coming small voltage signal. If any cut in the Brake wire there is no voltage signal in the braking end so signal and conditioning unit send the signal to control. Now the control unit activates the alarm through the driver circuit. The alarm gives the audible Indication to the Rider.

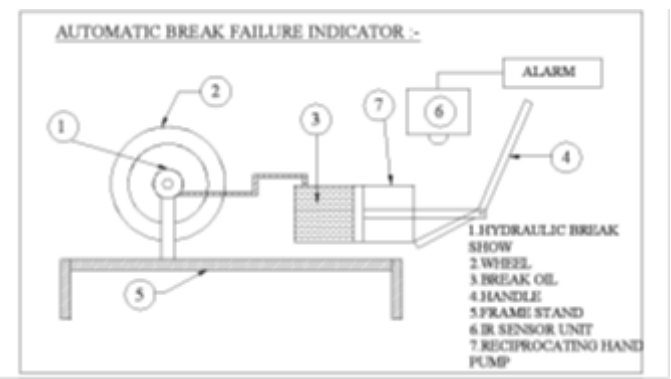

Figure-2

V.CIRCUIT WORKING

Here is a brake failure indicator circuit that constantly monitors the condition of the brake and gives an audio-visual indication. When the brake is applied, the green LED blinks and the piezo buzzer beeps for around one second if the brake system is intact. If the brake fails, the red LED glows and the buzzer stops beeping. The circuit will work only in vehicles with negative grounding. It also gives an indication of brake switch failure. In hydraulic brake systems of vehicles, a brake switch is mounted on the brake cylinder to operate the rear brake lamps. The brake switch is fluid operated and doesn't function if the fluid pressure drops due to leakage. The fluid leakage cannot be detected easily unless there is a severe pressure drop in the brake pedal. This circuit senses the chance of a brake failure by monitoring the brake switch and reminds you of the condition of the brake every time the brake is applied. The circuit uses an op-amp IC CA3140 (IC2) as voltage comparator and timer NE555 (IC3) in mono stable configuration for alarm. Voltage comparator IC2 senses the voltage level across the brake switch. Its non-inverting input (pin 3) gets half the supply voltage through potential divider resistors R3 and R4 of 10 kilo-ohms each.

The inverting input (pin 2) of IC2 is connected to the brake switch through diode D1, IC 7812 (IC1) and resistor R2. It receives a higher voltage when the brake is applied. Normally, when the brake is not applied, the output of IC2 remains high and the red LED (LED1) glows. The output of IC2 is fed to trigger pin2 of the mono stable through coupling capacitor C2. Resistor R1 is used for the input stability of IC2. IC1 and C1 provide a ripple-free regulated supply to the inverting input of IC2.IC3 is wired as a mono stable to give pulse output of one second. Timing across the brake switch. Its non-inverting input (pin 3) gets half the supply voltage through potential divider resistorsR3 and R4 of 10 kilo-ohms each. The inverting input (pin 2) of IC2 is connected to the brake switch through diode D1, IC 7812 (IC1) and resistorR2. It receives a higher voltage when the brake is applied. Normally, when the brake is not applied, the output of IC2 remains high and the red LED (LED1) glows. The output of IC2 is fed to trigger pin 2 of the mono stable through coupling capacitor C2.

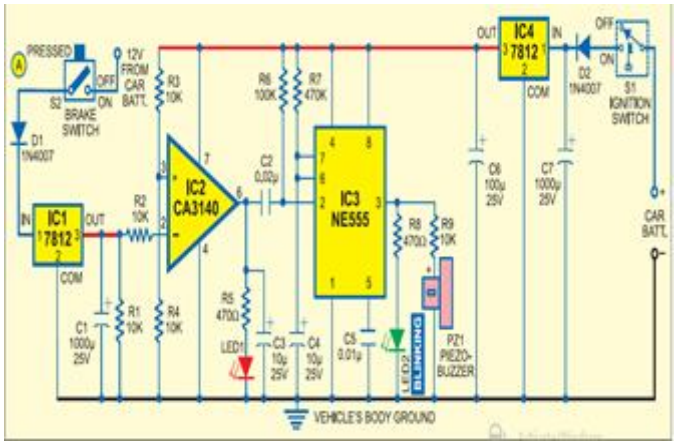

Figure-3

Resistor R1 is used for the input stability of IC2. IC1 and C1provide a ripple-free regulated supply to the inverting input of IC2.IC3 is wired as a mono stable to give pulse output of one second. Timing elements R7 and C4 make the output high for one second to activate the buzzer and LED2. Usually, the trigger pin of IC3 is high due to R6 and the buzzer and LED2 remain 'off.' When the brake pedal is pressed, pin 2 of IC2 gets a higher voltage from the brake switch and its output goes low to switch off the red LED. The low output of IC2 gives a short negative pulse to the m o n o s t a b l e through C2 to trigger it. This activates the buzzer and LED2 to indicate that the brake system is working. When there is pressure drop in the brake system due to leakage, LED1 remains 'on' and the buzzer does not sound when the brake is applied. The circuit can be assembled on any general-purpose PCB or perforated board. Connect point A to that terminal of the brake switch which goes to the brake lamps. The circuit can be powered from the vehicle's battery. The circuit requires well-regulated power supply to avoid unwanted triggering while the battery is charging from the dynamo. IC4, C6 and C7 provide regulated 12V to the circuit. The power supply should be taken from the ignition switch and the circuit ground should be clamped to the vehicle's body. A bicolour LED can be used in place of LED1 and LED2 if desired

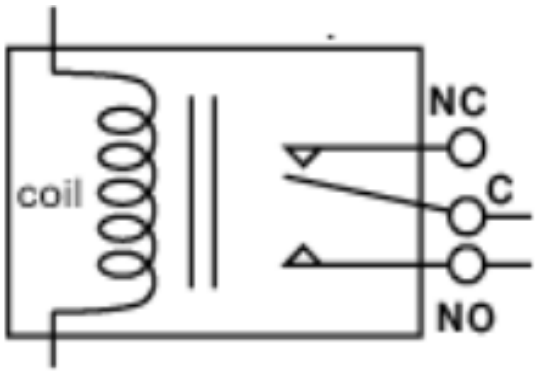

Figure-4

Figure 4 represents the symbolic diagram for electromagnetic relay. Shunt motor is a DC motor which consists of field winding and armature winding .This motor can be used in regenerative mode. In this mode motor acts as generator and power is supplied form the motor. To when the relay is switched the field winding is excited and a braking effect is produced. The kinetic energy is converted into electrical energy and can be stored in the battery. Power electronics controller is employed to condition the output of the motor and to charge the battery.

Figure-5

The Auxiliary Braking system was implemented in the formula race car designed and fabricated for SUPRA SAE 2014 event. Figure 5 shows the pressure transducer arrangement in the master cylinder of the car.

VI. BLOCK DIAGRAM DESCRIPTION

1. Switching circuits

The switching circuit consists of a brake switch, Ignition switch, diode 1N4007. Brake switch is used for giving brake to the entire device. Ignition switch gives supply distribution of 12V to the entire circuit.1N4007 diode is based on unidirectional property.

2. Voltage comparator

A comparator is a circuit which compares a signal voltage applied at one input of opamp with a known reference voltage at the other input. Here IC3140 as voltage comparator, it senses the voltage level across the brake switch

3. Monostablemultivibrator

Monostablemultivibrator has one stable state and the other is quarsi stable state. The circuit is useful for generating single output pulse of adjustable time duration in response to a triggering signal. The width of the output pulse depends only on external components connected to the operational amplifier. Here we use the IC NE555 as monostablemultivibrator. And the output of the voltage comparator block connected to the input of the IC.

4. Indication devices

Here LED and piezo buzzer are used .Minimum voltage of the LED are 1.2v and minimum current of the LED are 1015µA. Piezo buzzer is sound producing devices.

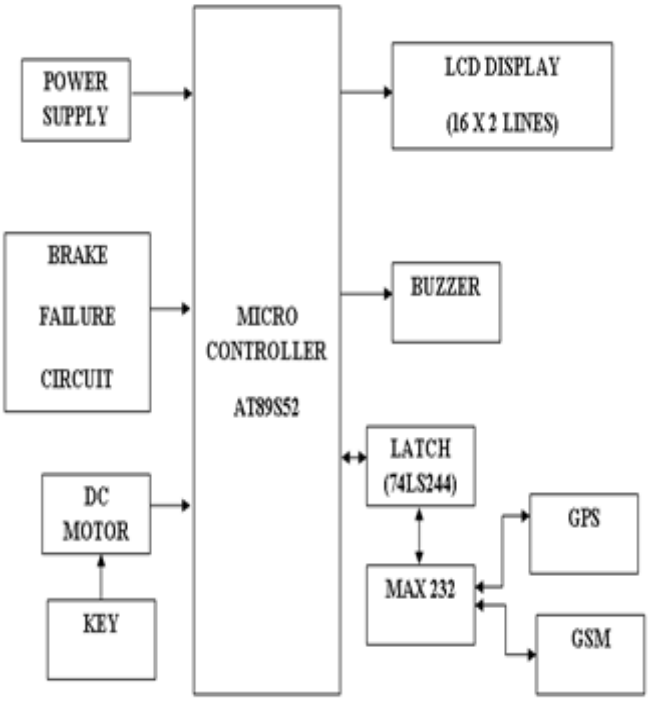

Figure-6

Figure 6 represents the primary braking system and the hub motor arrangement for the auxiliary braking system

Figure-7

6. COMPONENTS REQUIRED

SL NO	COMPONENT	SPECIFICATION	QUANTITY
1	Diode	IN4007	2
2	IC	7812 CA 3140 NE555	2 1 1
3	Resistor	10K 100K 470Ω 470K	5 1 2 1
4	Capacitor	1000µF,25V 100µF,25V 10µF ,25V 0.01µF 0.02µF	2 1 2 1 1
5	Switch	Brake Switch Ignition Switch	1 1
6	LED	Red LED Green LED	1 1
7	Piezo buzzer	Ceramic	1
8	DC Socket	12v	1

VII. CALCULATIONS

Force calculation for braking system:
T = P*60 / 2*π*N in N/m
Force = T/R
Where P = power in W
N = Speed in rpm
T = Torque in N/m
R = radius in m
The rated power of the hub motor is 745.68 W.
The rated speed is 1500 rpm.
T = 745.68*60/2* π*1500
= 4.749 N/m
F = 25 N

The force of 25 N is applied on each of the rear wheels. Hence the net braking force is 50 N.

This force is sufficient to maneuver the vehicle and safely stop the vehicle and prevent accidents.

VIII. ADVANTAGES

1. No need of external battery. Circuit can be powered from the vehicle's battery itself.
2. Power consumption is comparably less.
3. Does not depend on the petrol level.
4. Operating principle is very easy
5. Installation is simplified very much
6. The safety of driver is ensured
7. The regenerative braking recovers energy and stores it in battery.
8. Brake failure is notified to the surrounding traffic via parking lights.
9. The cost is low

IX.CONCLUSION

The project gave us more confidence that we will be able to put in practice, whatever theoretical knowledge. we gained during our course of study till now. If really persuades us to do more and more, perhaps in better way in our future. Brake failure indicator is a early warning system. it constantly monitors the condition of the brake and give audio visual indication. This setup reduces the accidents and prevents loss of life. Auxiliary braking gives additional capability to the driver and to ensure prevention of damage to life and property

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