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Research Paper

Brake failure detection and electronic auxiliary braking system

N. Deepa*, Sanchayita Dasmunshi, Shubhangi Verma, Anurag Shukla, Sneha Nanda

(Asst. Prof.), SRM University, Chennai, India
**Corresponding Author Email: deepa.n@ktr.srmuniv.ac.in*

Abstract

Brakes are the integral part of a vehicle, which are used to reduce the speed of the car. Brake failure is one of the major problems, which lead to several accidents. Brake failure occurs due to brake lining fails, which leads to pressure loss. This mainly occurs in pneumatic brakes, which are used in most of the vehicles. The aim of our paper is to diagnose the faulty braking system and to enable the functioning of auxiliary braking or secondary brake system during brake failure. When the primary pneumatic brake fails the pressure sensor detects the brake failure and gives warning signal to the driver and also enables the auxiliary brake, which can be controlled by the driver manually through a manual control board. This braking system ensures the safety of the driver as well as the passengers without causing any damage to the vehicle.

1. Introduction

The main purpose of the paper is to ensure the safety of the driver and the vehicle by enabling the auxiliary or secondary braking system. A brake is a mechanical device that inhibits the motion of the vehicle by slowing it down. Brakes retard the motion of the body by creating friction between two moving surfaces and converting kinetic energy to heat energy. The brake failures usually occur due to the cut off of brake lining, causing a pressure loss. Hence the brake shoe doesn't apply the require pressure in the disc.

The pressure loss is detected by the pressure sensor, which also works as a transducer. The transducer sends electrical signal to the controller. The controller displays the brake failure detection through a Liquid Crystal Display and enables the manual keyboard, which the driver uses to reduce the speed. The supply is provided through the car battery. An electrical buzzer is also connected so that it warns the other cars near the vehicle about its brake failure.[1]

2. Working Module

The pressure when applied within a certain range changes the break proportionally, which signifies that the break is working normally, thus displaying the amount of pressure and showing that it is in the automatic mode.[2] In the case where there is no change in pressure, i.e. pressure loss, for a certain period of time a break failure is indicated with the help of the pressure sensor (BMP180) which causes the display indicator to show break failure and shifts it from automatic mode to manual mode and simultaneously the buzzer goes on and thus gives an audio indication as well [3].

Now in the manual mode the driver can control the car manually by pressing a button via a keyboard, which will cause the change in speed by 80%, 50%, and 25%and slowly causes it to stop. So the driver has an option to realize at what retardation rate he would want the car to function according to the surrounding condition [4].

In case the auxiliary break fails there is an option to completely stop the car, which would save the passenger, as well as the car. This last method is applied only if all the other options are not available.

In the entire process the temperature of the car is kept under check by the temperature sensor (LM35) it shows the temperature on the display unit. If it crosses the indicated limit the pump automatically starts working and the visual indication of overheats is shown along with an audio buzzer, thus keeping the temperature under control.

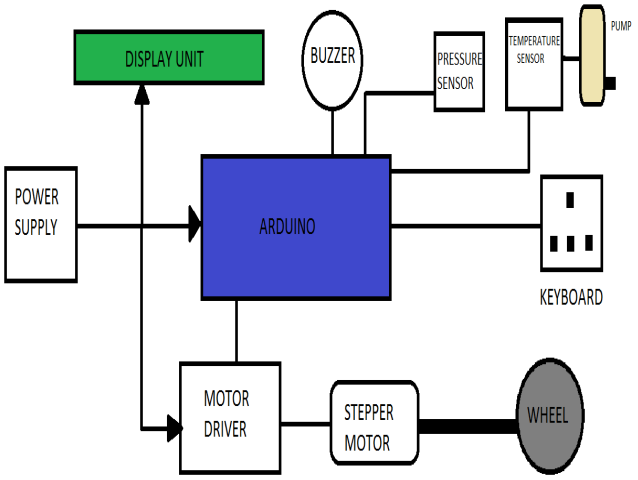


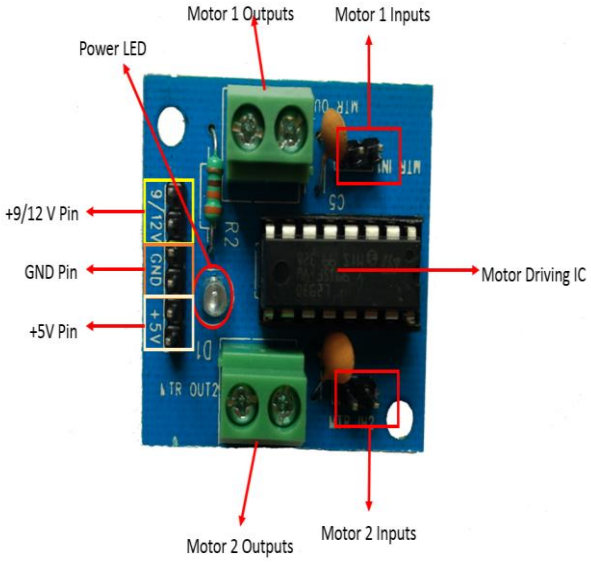
Fig. 1

3. List of Components

- L293D- Motor driver
- Stepper Motor
- BMP 180- Pressure sensor
- LM 35- Temperature sensor
- LCD display
- Arduino Uno- ATMEGA328
- Buzzer

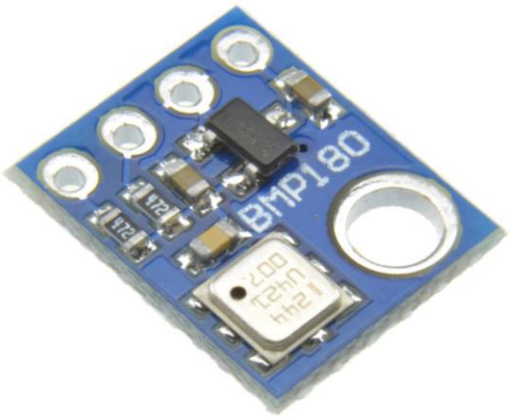
- Manual Control- 186C
- ULN 2003

L293D is a motor driver IC that allows this motor to rotate on either direction. It is an IC with 16 pins and it controls 2 DC motors simultaneously in any direction. The L293D is used to drive the stepper motor whose shaft is attached to a wheel, which rotates as the motor shaftrotates.



ULN2003 is appropriated for combining the logic circuitry and multiple peripheral loads; high current and voltage Darlington arrays attributes load ratings to 500mA for each seven drivers. At an appropriate duty cycle it depends on temperature and number of drivers turning ON simultaneously, over 230W of typical power loads can be controlled. Relays, stepper motor, solenoid, complex combinations of LCD are classified under complex loads.

BMP 180 is a precision sensor, which is aneconomical sensing method for analysing pressure and temperature. The sensor is soldered to a programmable circuit board with a regulator of 3.5V and level shifter and resistors on the level shifter pins.



A high performance 8-bit microcontroller is used which consumes low power and is also based on RISC architecture which is AVR enhanced, the ATMEGA32***8***. In a single clock cycle powerful instructions are executed at the ATMEGA328 which allows the system designer to escalate power consumption and processing speed. It accesses output at a rate1 MIPS per 1 MHz. The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put intoDFU mode.

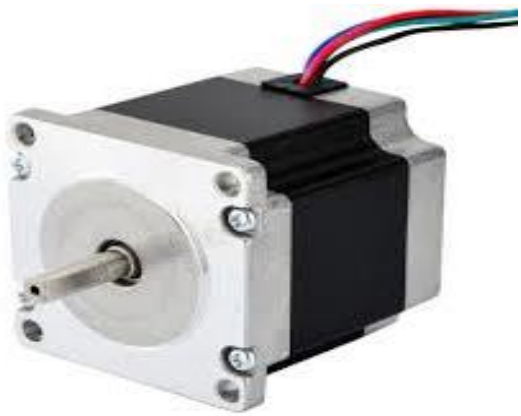
Stepper Motor, brushless DC electric motor, divides full rotation into equal number of steps. Itcan be positioned to move and hold at steps without a position sensor for feedback (an open-loop controller), as long as itfunctions in accordance to torque and speed.

Switched reluctance motors are large stepping motors with reduced pole count, and are closed-loop commutated.

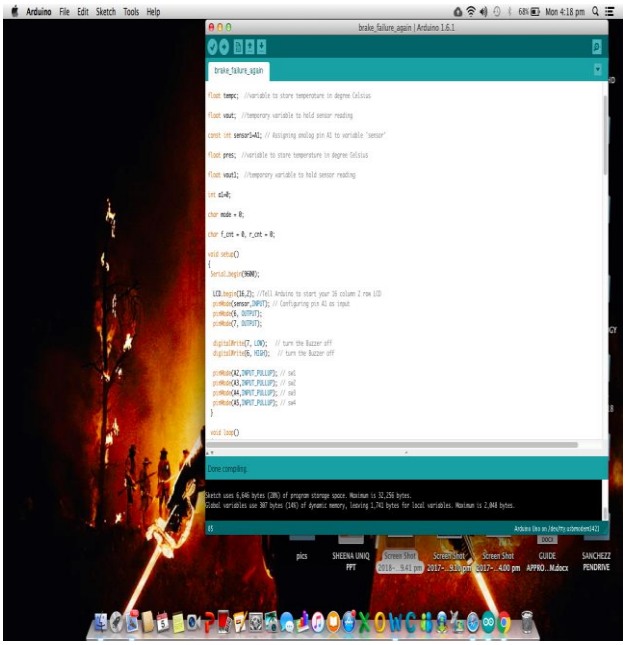
The types of stepper motors, namely:

1. Permanent magnet stepper
2. Hybrid synchronous stepper
3. Variable reluctance stepper

Permanent magnet motor works with permanent magnet (PM) in the rotor and is based on the principle of attraction or repulsion between the rotor PM and the stator electromagnets. V R motors have a simple rotor made up of iron and is based on the principle of minimum reluctance occurs with minimum gap; as a consequence the rotor points and the stator magnet poles attract each other.



4. Implemented Codes



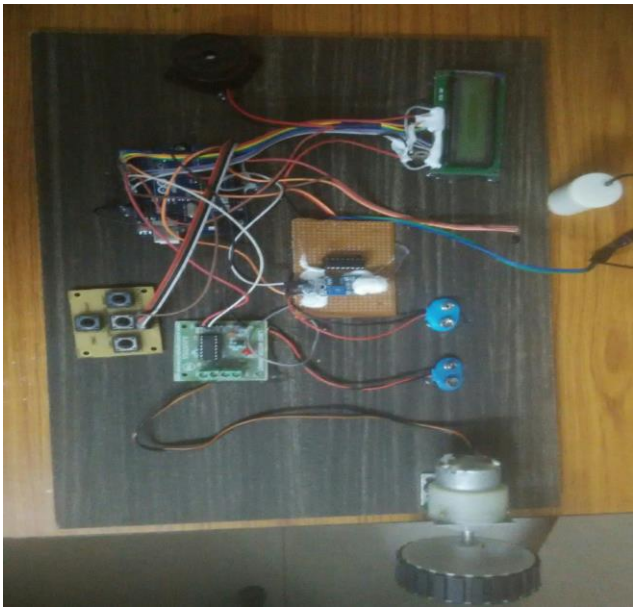


Fig. 2

5. Conclusions

The drivers as well as passenger's safety are concerned, as life is precious. The electronic auxiliary braking system will play a vital role in the world of automobile with its effective cost and working efficiency. The system is highly reliable both for two and four wheelers. Initial testing has shown positive result and may revolutionize the modern braking system.

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