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Research Paper

DESIGN OF BRAKE PAD WEAR INDICATING SYSTEM

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The braking system of a car is indubitably one of its most significant features and any failure in the system can result in. Mainly brake failure occurs because of worn out of brake shoe/pad and pressure leakage from the cylinder. The aim of this work brake pad wear indicating system is to keep a check on this by introducing indicating system for brake pads. Automatic Brake Pad Wear Indicating consists of position sensor. Sensor is connected with the brake shoe; the signal from the sensor is given to a microcontroller (Arduino). When the brake shoe is worn out, the sensor sends signal to the microcontroller. The microcontroller analyzes the signal and glows the light if there is any fault in the brake pad which informs the user about the condition of the brake, thus limiting the chances of malfunction.

Keywords: Position sensor, Brakes, Microcontroller, Braking system, Arduino, Brake pad, Brake failure

INTRODUCTION

As per the data cited in certain reports, India recorded at least 4,80,652 accidents in 2016, leading to 1,50,785 deaths. Brake failure accounted for roughly 22% of those accidents brakes. Several factors can interfere with the friction between the disc and the calipers which leads to brake failure: Grease or oil on brakes causes brake failure, because it interferes with friction. If oil leaks, it may indicate that an oil seal has failed or when the brakes overheat to a great degree, the metal in the brake rotors or drums develops hard spots. These are known as hot spots. The hot spots resist the friction from the brake shoes and pads. Because the shoes or pads have nothing they can grasp, there's no friction. Consequently, braking power is lost. Brakes that squeal indicate that the brake pads are wearing thin.

Automatic Brake Pad wear Indicator is an integrated system that can be used in modern cars to provide user with instant data on brake pad condition. The sensors used will be placed at defined locations of concern which would

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fetch the information about the condition of brake pad.

We will be using Electronic Control Unit (ECU) as our main board and sensor will collect all the real time data from environment and processed by the concerned output mechanism.

During the research, it was found that there exist 2 main problems with the pre-existing system is that does not give us a visual indication of brake pad wear, the system does not give a pre indication of brake pad wear.

The aim behind this research was to develop a retrofit which can be fitted aftermarket and also can be used in cars with manual transmission.

MATERIALS AND METHODS

The working of this program is such that it takes the input data from the sensor processes it and tells the microcontroller to give a high or low signal to the sensor or receiver to indicate whether the pad wear has taken place and has reached its critical distance. The design process included designing the basic units for sensing the distance.

Inductive Proximity Sensor (PNP Diode Type)

An inductive proximity sensor can detect metal targets approaching the sensor, without physical contact with the target. Inductive Proximity Sensors are roughly classified into the following three types according to the operating principle: the high-frequency oscillation type using electromagnetic induction, the magnetic type using a magnet, and the capacitance type using the change in capacitance.

A high-frequency magnetic field is generated by coil L in the oscillation circuit. When a target approaches the magnetic field, an induction current (eddy current) flows in the target due to electromagnetic induction. As the target approaches the sensor, the induction current flow increases, which causes the load on the oscillation circuit to increase. Then, oscillation attenuates or stops. The sensor detects this change in the oscillation status with the amplitude detecting circuit, and outputs a detection signal.

The sensor we used

1. Brand - INFRA
2. Type - M-18 PNP
3. Range - 5 mm
4. DC, 3 wire

Computer Processing (Arduino Uno R3)

- Arduino Uno R3 is a credit card sized single-board.
- It can be used as a personal computer, as well as a microcontroller.
- It has many GPIOs pin, those pins are programmable using software and can be used to start or stop a device. GPIOs can only provide voltage of 0 V or 3.3 V (low or high).

Sensing

The purpose of this unit is to detect (sense) all the parameters desired using a collection of sensors that are used according to design to achieve the best performance.

Eddy current or inductive proximity sensor will help in detecting the brake pad wear by calculating the change in distance between sensor and the disk.

Electronic Computer Unit (Arduino Uno R3) Processing

This is the most important unit and the core of the system. It handles all the processing and

controlling needed for the system to function. It receives the sensing information, processes it, returns the corresponding values, and generates the necessary controls to guide the data to the desired destination.

Connect to Sensors

Each of the system's sensors is connected to the ECU by pins in different configurations.

Software Design

Before writing the code for the system, several software dependencies will require installation. These dependencies add more functionality to the use of C language on Arduino and make the software design process easier.

Figure 1

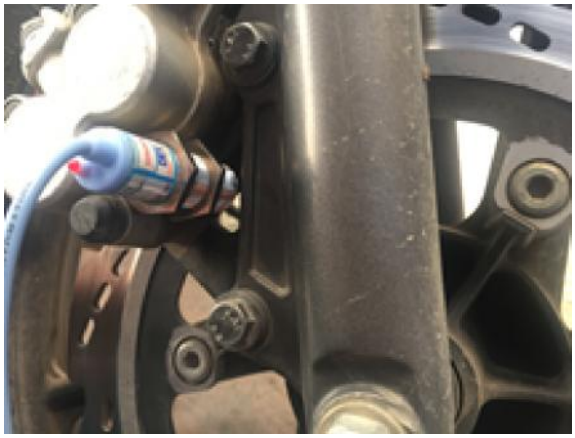

Figure 2

This is the actual photo of the sensor attached to the caliper.

Microcontroller used here is Arduino UNO R3.

Arduino Coding

This c language program is feed inside this Arduino. This program helps us in showing the result of brake pad wear distance calculations.

```
intlimitSwitch = 13;
int state = LOW;
void setup() {
    Serial.begin(9600);
    pinMode(limitSwitch,INPUT);
}
void loop() {
    intval = digitalRead(limitSwitch);
    if(val != state ){
        state = val;
        Serial.print("Sensor value = ");
        if( state == 0 )
        Serial.println( "(1) none" );
        else
        Serial.println( "(0) hit");
    }
}
```

Some other algorithm for arduino can be used with respect to different results and sensor.

RESULTS

Initial brake pad thickness = 12 mm

Brake pad critical thickness = 3-4 mm

These observations were found after continuous use of brakes on Apache RTR 160 bike. For the brake pads to wear down to these figures, it took 6-8 months of rigorous use of the bike. It was also observed that once the indicator started to glow the brakes weren't as efficient as they were before and the stopping distance had increased, be certain distance along with the driver effort.

CONCLUSION

1. To give the audio visual indication when there is a mistake in braking system.
2. By devising a mechanism of this sort, driving will become safer and most importantly, this sort of technology could reach the person who form the majority in any economy and help in reducing the number of accidents due to brake system inefficiency.
3. Smaller and more accurate sensors can be used like eddy current sensor for more accurate and flexible result and where assembly is constraint.

Advantages

1. Number of accidents will be less by this approach.
2. It can be fitted in any vehicle irrespective of its type.

Scope for Future

1. Response time of sensor and microcontroller can be reduced.
2. In present, it is a retrofit but in near future it can be preinstalled in vehicle during production and assembling of parts.
3. If in case the brake pad reaches its critical thickness, brake indicator can also be used in order to shut down the vehicle's engine.

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