Microprocessor Based Speed Control System for Two-Wheelers (MSCS)

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Abstract: ***In developing countries like India, Two wheelers provide an affordable form of personal transportation. High traffic congestion and general poor quality of roads expose the rider to high risks, making it a stressful and risk loaded experience for the rider. This results in physical discomfort and affects the quality of ride. In this paper an attempt is made to demonstrate the simulation process of controlling the speed of a two-wheeler automatically using MSCS. A prototype is constructed using a robot prototype MSCS consists of2 sensors namely infra-red sensor and piezoelectric sensor where infra-red sensors is used to evaluate proximity of a vehicle ahead of it while piezoelectric sensors senses the quality of the road by detecting pot-holes and speed breaker bumps. The signals that are generated from these sensors are mapped against the speed of the vehicle, and thus automatically reducing the speed of the vehicle. The signals that are obtained by the sensors are fed to a microprocessor and compared with a standard value. Depending on the deviation from the standard value, the microprocessor then operates a servomotor linked to the brake lever and brakes are applied. This process of self-automation helps the rider in having a smooth and safe ride with minimum discomfort.***

Keywords: Speed Control, Microprocessor, Sensors

1. Introduction

Accidents and deaths on roads are mainly due to man made errors. Safety has not been given importance in our development and expansion of mobility and motorization networks. Some of the identified risk factors like drinking and driving, increasing speeds, improper design of highway, vehicle congestion, etc. contribute in a significant way.

Road crashes are predictable and preventable and can be controlled effective. This requires a safe integrated (between government, riders and vehicle manufacturers) system with importance given for making safe roads and safe vehicles that can effectively contribute for reducing crashes.

Since safety has become an ever-increasing demand for the automotive industry, anti-lock breaking system, electronic break force distribution etc. have been designed to improve the vehicle handling and the rider's safety.

In aid to this we have proposed an engineering solution to control the speed of the vehicle using sensors and breaking system. The piezoelectric device which converts mechanical energy to electrical energy is used as a terrain sensor, along with infrared sensor as a proximity sensing device.[1] The combination of sensors provides an automatic breaking system for two wheelers, thus reducing the risk of accidents.

2. Proximity Sensor

2.1 Concept

A Proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact. In this case infrared sensor is used. Infrared sensor in an electronic sensor that measures infrared light radiating from objects in its field of view. An infrared sensor detects changes in amount of infrared radiation impinging upon it, which varies depending on temperature and surface characteristics of object in front of the sensor. When an object passes in front, the temperature in that point on the sensor field will vary, also, moving objects of similar temperature but different surface characteristics will have different infrared emission pattern.

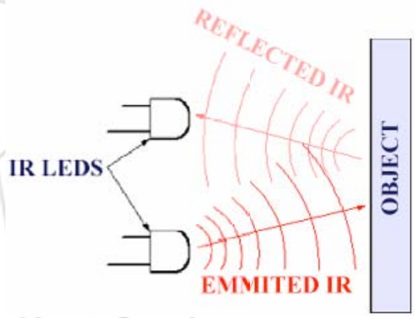

Figure 1: Infra Red Sensor (Principle)

2.2 Working

To detect the presence of an obstacle at the earliest, the proximity setup is to be mounted on the foremost part of the vehicle, which could either be the front fender or the cowling/ front faring of the two-wheeler.The setup consists of an infrared sensor and an emitter connected to the microprocessor. The emitter sends out signals and when an object interrupts the signals, they bounce back and are sensed by the sensor. The signals that are obtained is the measure of relative distance between sensor and object. According to the program logic, if the infrared signal input exceeds a certain value then control signals are sent to servomotor and thus breaks are applied. If the infrared signal input exceeds a standard value that is indicative of the minimum relative distance between sensor and obstacle, then control signals are sent to servomotor linked to the break lever, which in turn applies brakes.

Figure 2: Mounting of proximity sensor – front fender

Figure 3: Mounting of proximity sensor - cowling

2.3 Experiment

In an experiment that was conducted the Infrared sensor value at different distances with respect to a standard obstacle was obtained. Corresponding graph proves that IR value directly gives the measure of proximity of the obstacle.

Table 1: Distance in cms v/s Infra Red Sensor values

Distance (cms)	Infrared Sensor Value
0	520
2	500
4	480
6	460
7.5	400
10	285
12.5	230
15	200
17.5	175
20	160
∞	135

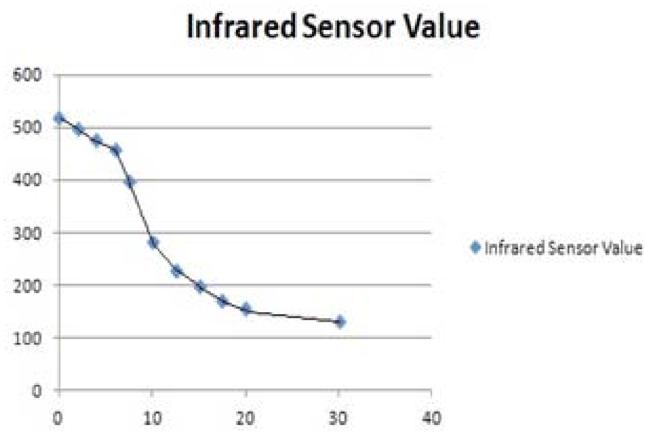

Figure 4: Distance v/s infra red sensor value

In the program logic, it is set in such a manner that for the signal value at a certain standard distances (15cms in this case), brakes are gradually applied and the vehicle is slowed down. At a certain critical value (6cms) the vehicle completely stops, preventing collision with the obstacle.

3. Piezoelectric Sensors

3.1 Piezoelectric Material

A material is deemed piezoelectric when it has the ability to transform electrical energy into mechanical strain energy and likewise, transform mechanical strain energy into electric charge. Piezoelectric material that exists naturally as quartz has poor reliability as a sensor, while artificial piezoelectric materials such as Polyvinylidene fluoride (PVDF) seemed to produce a reliable stable signal for the given variation in load. Thus PVDF strip is used as a sensory device in order to obtain measure of deflection of suspension springs. [2]

Figure 5: PVDF sensor

3.2 Working

The piezoelectric sensor is to be placed as a part of the unsprung mass of the vehicle suspension system. The optimal position would be between the spring and spring coupling to obtain the most favorable signal for processing. When there is a change in the terrain, a net deflection is observed in the coil of the front suspension (springs) and there will be a load applied on the piezoelectric sensor. This sensor is connected to the microprocessor. The net positive output voltage that is obtained irrespective of type of force applied (compressive or tensile), is the measure of deflection of the spring/ coil (present in the suspension system). [3]. As per the program logic compiled into the microprocessor, if this exceeds the minimum standard value of ratio of speed versus output voltage, the servomotor is actuated and thus brakes are applied.

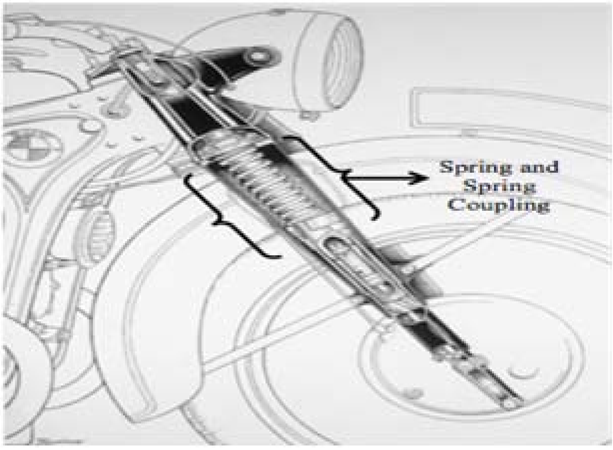

Figure 6: Mounting of piezoelectric sensor – between spring and spring coupling

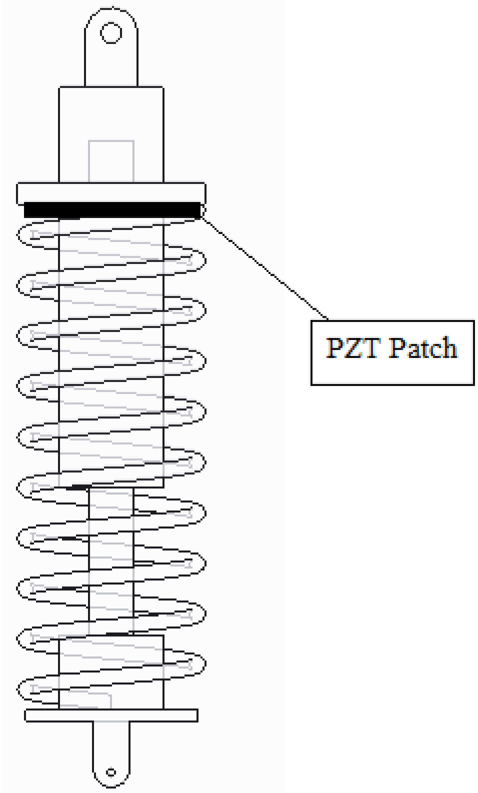

Figure 7: Mounting of piezoelectric sensor – CAD model

3.3 Figures and Tables

From the graph, it is evident that the output voltage is a function of deflection at the tip, which is a measure of the spring deflection, which in turn is caused due to change in terrain. The ratio of speed to output voltage can serve as a trigger to apply brakes automatically whenever there is a change in terrain.

Table 1: Tip deflection in mm v/s output voltage in V

Tip Deflection (mm)	*Voltage Output (V)*
2	7
5	15
10	20-25
Max	> 70

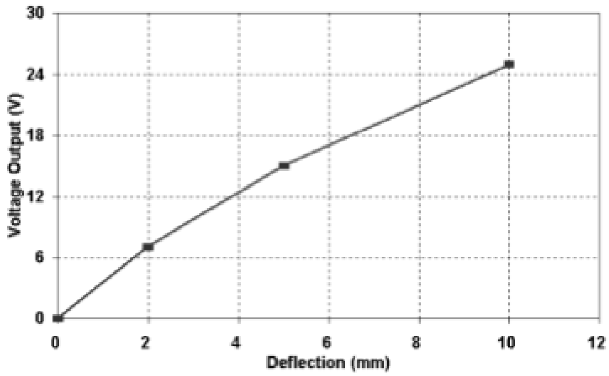

Figure 8: TipDeflection in mm v/s output voltage in V

4. Conclusions

- In case of electric vehicles, the signals from the sensors are processed and logical decisions are made. speed control is obtained by directly changing the speed of the electric motor which is by virtue of the control signal sent by the microprocessor.
- In IC engine vehicles, the output signals from the sensor is sent to the microprocessor, decisions are made according to the designed program and the control signal is then sent to a servo motor. A brake lever is connected to the servomotor on one end and the other to the brake pads. The signals obtained from the microprocessor controls the servomotor and thereby controlling the lever, thus applying the brakes.

Thus when implemented, MSCS can serve as an excellent system where haphazard driving which is a result of traffic congestion is checked as well as reducing the risk of accidents that are due to unscientific planning of highways and city infrastructure therebysaving lives.

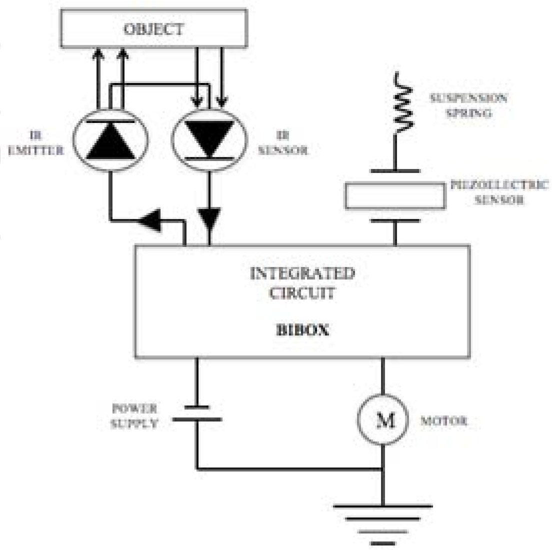

Figure 9: Block diagram of circuit working

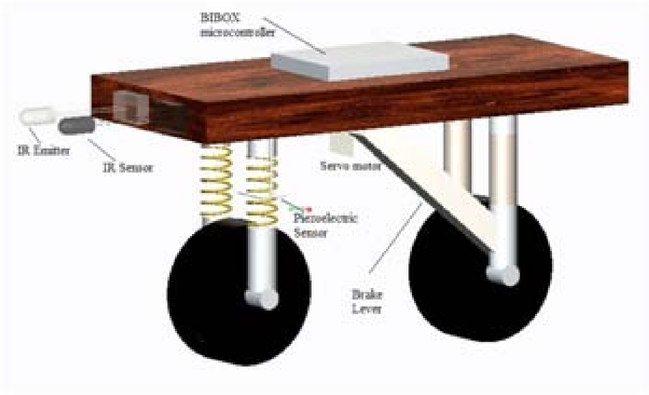

Figure 10: CAD model of Setup

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