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Design of Intelligence Braking System

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I-INTRODUCTION

Driving is a compulsory activity for most people. People use cars to move from one place to another. The number of vehicles is increasing day by day. Nowadays, the numbers of accident is so high and uncertain. Accidents occur frequently and cause worse damage, serious injury and death. These accidents are mostly caused by delay of the driver to hit the brake.

The braking system was designed and applied on a car to make the driving process safety using embedded system design. Currently, vehicles are often equipped with active safety systems to reduce the risk of accidents, many of which occur in the urban environments. The most popular include Antilock Braking Systems (ABS), Traction Control and Stability Control. All these systems employ different types of sensors to constantly monitor the conditions of the vehicle, and respond in an emergency situation.

DEFINITION

An intelligent mechatronic system includes an ultrasonic wave emitter provided on the front portion of a car producing and emitting ultrasonic waves frontward in a predetermined distance. An ultrasonic receiver is also placed on the front portion of the car operatively receiving a reflective ultrasonic wave signal. The reflected wave (detected pulse) gives the distance between the obstacle and the vehicle and RPM counter gives speed of vehicle. The microcontroller is used to control the braking of the vehicle based on the detection pulse information to push the brake pedal and apply brake to the car stupendously for safety purpose.

II- COMPONENTS

2.1. Ultrasonic sensor:

An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object.

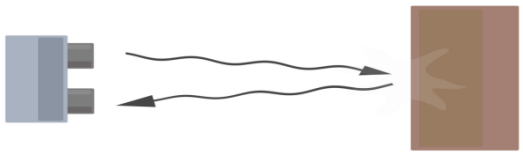

Figure: 2.1 ULTRASONIC SENSORS

2.2. Microcontroller:

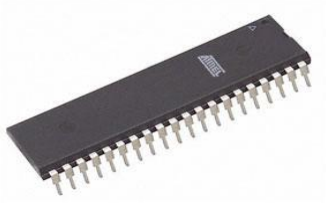

Figure: 2.2 ATMEGA 16

All output signals generated from flex sensors are in analogue form and these signals need to be digitized before they can be transmitted to encoder. Therefore microcontroller ATMEGA 16 is used as the main controller in this project. It has inbuilt ADC module, which digitizes all analogue signals from the sensors and inbuilt multiplexer for sensor signal selection. It supports both serial and parallel communication facilities.

ATmega16 is an 8-bit high performance microcontroller

of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz.

ATMEGA 16 devices are available in 40-pin

- It is 8-bit Microcontroller
- System is RISC Architecture
- It has Small set of Instruction set
- It has 131 powerful Instructions
- Compatibility avail 28/40 Pin Ics
- Operating Speed Max 16 MHz, Voltage 2-5.5 v
- Memory: Flash Program-16KB, RAM-1 KB, EEPROM Data Mem- 512 Bytes
- Low power, High speed Flash/EEPROM Technology
- It has on chip Timers. 2 Timers are avail
- It has in built Analog to Digital Converter, USART, Analog Comparator, SPI JTAG etc
- In built Multiplexer availability for signal Selection
- It has serial as well as Parallel Communication facilities

2.3 Piston/Piston cylinder

In general, a piston is a lubricated sliding shaft that fits tightly inside the opening of a cylinder. Its purpose is to change the volume enclosed by the cylinder, to exert a force on a fluid inside the cylinder, to cover and uncover ports, or some combination of these. A rubber seal is sometimes used to keep the lubricate within the shaft. A disk or cylindrical part tightly fitting and moving within the cylinder, either to compress or to move fluid collected in the cylinder as air or water, or to transform energy imparted by a fluid entering or expanding inside the cylinder, as compressed air, explosive gases or steam into a rectilinear motion usually transformed into rotary motion by means of a connecting rod.

For Disc Brake
Working pressure:150psi
Max pressure :300psi
Stroke length:50mm
Diameter:20m

Figure: 2.3 PNEUMATIC PISTON

2.4 Accelerometer

An accelerometer is a device that measures proper acceleration. Proper acceleration being the acceleration (or rate of change of velocity) of a body in its own instantaneous rest frame, is not the same as co-ordinate acceleration, being the acceleration in fixed co-ordinate system.

Accelerometers are electromechanical devices that sense either static or dynamic forces of acceleration. Static forces include gravity while dynamic forces can include vibrations and movements. Accelerometers can measure acceleration in 3-axis.

Generally accelerometers contain capacitive plates internally. Some of these are fixed while others are attached to miniscule springs that move internally as acceleration forces act upon the sensor. As these plates move in relation to each other, the capacitance between them changes. From these changes in capacitance, the acceleration can be determined.

Working voltage – 5 volt
Size – 25*25 mm

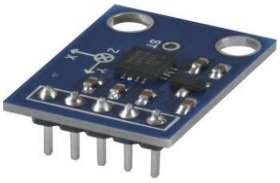

Figure: 2.4 ACCELEROMETER

2.5 Motor

A D.C. motor is a device that converts electrical energy into mechanical energy. The very basic construction of a D.C. motor contain a current carrying armature which is connected to supply end through commutator segments and brushes. The armature is placed between north pole and south poles of a permanent magnet. As soon as we supply direct current in the armature, a mechanical force acts on it due to electromagnetic effect of the magnet. The working of D.C motor is based on principle that when a current carrying conductor is placed in a magnetic field, it experiences a mechanical force.

Operating voltage – 12v D.C.Torque – 50 kg.cm
Shaft diameter – 8 mm

Figure: 2.5 DC MOTOR

2.6 Compressor

A compressor is a Mechanical Device that increases pressure of a gas by reducing its volume. An air compressor is a specific type of gas compressor. An air compressor is a device that converts power into potential energy stored in pressurized air. By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. When tank pressure reaches its upper limit the air compressor shuts off. The compressed air is then held in the tank until called into use. The energy contained in the compressed air can be used for a variety of applications, utilizing the kinetic energy of the air as it is released and the tank depressurizes. When tank pressure reaches its lower limit, the air compressor turns on again and re-pressurizes the tank.

Operating voltage – 12v D.C

Maximum pressure – 300 psi

Compact size with pressure gauge

.

Figure: 2.6 COMPRESSOR

2.7 Battery

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flash lights, electric cars. A rechargeable battery is a type of electric battery which can be charged discharged into load and recharged many times as opposed to a disposable or primary battery, which is supplied fully charged and discarded after use. It is composed of one or more electrochemical cells. The term accumulator is used as it accumulates and stores energy through a reversible electrochemical reaction.

Specification – 12 v 7.5Ah rechargeable battery

Figure-2.7 BATTERY

2.8 Relay switch

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid state relays. Relays are used where it is necessary to control a circuit by a separate low power signal, or where several circuits must be controlled by one signal.

Figure: 2.8 RELAY SWITCH

III- DESIGN CALCULATION

3.1 Hub Design

- Outer diameter(D):40mm
- Inner diameter(d):22mm
- Calculation of shear stress:
- Rated torque of motor: 50kg-cm

=4.09N.m

Rated power= $2*\pi*N*T$ $=2*\pi*250*4.09$

60 60

=107.07 watt

- Design Power= Rated Power*k1

=107.07*1.5

=160.01 watt

- Design Torque=60*rated power

$2*\pi*N$

=60*160.61

$2*\pi*250$

=6.135N.m

- Design torque=$\pi/16 * \tau * (D^4-d^4)/D$

6.135 $=\pi/16 * \tau *(40^4-20^4)/40$

τ =0.001041MPa

3.2. Chassis Design

Chassis dimension: 1.21m(4ft)*0.6m(2ft).

Wheel base: 0.70m

Material of the chassis: Steel

Static load on wheels Fs = μf× Rn

= 0.6 × 50 × 9.81

Fs = 294.3N

IV- FABRICATION OF MODEL

Figure:4.1 WORKING MODEL

V- CONCLUSION

- In this project the innovative idea of implementing intelligent braking system is discussed and thereby analyzed.
- In this project ultrasonic sensor which is cheaper ,less demanding of hardware was used in order to detect the obstacle
- After detailed analysis it was observed that
  - Our prototype model when moving at speed of 15 kmph powered by a 30 rpm dc motor detected the obstacle at a distance of 0.5 meters.
  - On detecting the obstacle circuit is activated and pressure is released which actuates the piston cylinder and applies pressure on the disc brake.
  - The front bumpers moved forward on receiving signal from microcontroller and prevented damage to own vehicle.
- The total time taken by prototype to completely stop and actuate the bumper is 1.5 seconds.
- Also as soon as the accelerometer detected an inclination of more than 15 degrees the accelerometer signaled the circuit to switch from 12v to 24v battery as a result of which power supplied to motor increased. This led to increase in vehicle speed.
- On a downslope more than 10degrees the accelerometer gave the signal to slow the speed of the vehicle in order to prevent any accident.

VI- FUTURE SCOPE

Ultrasonic sensor is used to spot any object in line of action of the vehicle. Interference between the ultrasonic waves activates the micro-controller. It then gives control signal to the solenoid valve which activates the piston with the help of compressed air which ultimately results in braking of the vehicle.

- Bumper design can be further enhanced to act as external air bag.
- Accelerometer pedal disengagement mechanism can be used further.
- There is no recent research on parking problems so this system will be helpful to overcome from such problems.

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