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PWM Based Automobile Braking System

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Abstract - *Electric vehicles are emerging with increase in technology. When compared with conventional vehicles system, electric vehicles outrun the latter in most of the aspects related to automobiles. In electric vehicles, While driving along, energy flows from the batteries to the motors, turning the wheels and providing the kinetic energy needed to move. In the proposed system, ultrasonic sensors are used and automatic speed control is done using pwm technique. The ultrasonic sensors measure the distance of the obstacle and according to the corresponding distance the speed of the vehicle is regulated and reduced gradually. The speed is controlled proportional to the distance of the obstacle from the vehicle. In case of situations where sudden braking is needed overcoming inertia effect, the reverse pulses are provided. The pulses are reversed using H-bridge. Also skidding of the vehicle is prevented by using speed sensors and ultrasonic sensors***.**

Key Words: PWM, DC motor, Ultrasonic sensor, speed sensor

1. INTRODUCTION

An accident is defined as an unplanned and uncontrolled event in which action and reaction of an object or person results in personal injury or damage to the property. The volume of freight traffic movement has been dramatically increased in the country. It is a matter of serious concern that about 125,000 people get killed (estimated for the year 2009 by Central Bureau of Health Intelligences) in road traffic accidents in India and more than half a million are injured annually. This is a conservative estimate as not all motor vehicle accidents are reported just to avoid coercive and impractical adjudication system. It is estimated that the country loses around Rs.75,000 crore (estimated for the year 2009 by Central Bureau of Health Intelligences) annually due to road traffic accidents which is 2-3 percent of the GDP. The existing electric vehicles have technologies such as ABS (Anti-Locking Braking System), SRS Air Bags (Supplemental)

2. DESIGN OF THE SYSTEM

The main target for this project is to design an automatic brake for vehicles due to which car stops when sensor senses the obstacles. The braking circuit function is to brake the car suddenly without any further forward motion on detection of any obstacle. Automatic Braking is a technology for automobiles to sense an imminent collision with another vehicle, person or obstacle; or a danger and to provide protection by applying the brakes to slow the vehicle without driver input. The principle used for the automatic braking system is the Pulse width modulation implementation for DC motors which are present in latest electric cars. Efforts have been reported for sensing vehicle surroundings with different visible, non-visible (infrared) light and time-of flight sensors. Ultrasonic sensors are well accepted technology for distance sensing application. The Ultrasonic Sensor will give an analog value which is sent to PIC micro controller through ADC. The controller will calculate the distance accordingly to the ADC value and controls the input to the motor by varying the duty cycle of PWM pulses. Thus increasing or decreasing the speed of the motor is possible. At the same time when any obstacle is below the pre-set distance value, then automatically a sudden braking is provided. This allows the travel to be in a safe and secure manner. Manual control is provided for user convenience.

2.1 Basic Principle

First, the distance of the obstacle infront is sensed using ultrasonic. Based on the sensor output given to the microcontroller, the distance is calculated and compared with a standard reference distance. If the distance is within the defined critical limits, the microcontroller activates the brake control mechanism and slows down the vehicle or brings it to a halt. The sensor keeps track of any obstacle in the front continuous and it is given as input to microcontroller. This simple concept of measuring the relative distance between the two vehicles along with our proposed speed control mechanism will help in reducing the accidents to a great extent.

The control mechanism is based upon two major classification of cars: Electric cars (no gears) and Non Electric cars (with gear system) i.e. cars with internal combustion engine. In case of electric cars, the internal combustion engine of the vehicle is replaced usually with a DC electric motor generator along with some additional batteries. The concept of electric motors is relatively simple, capable of generating torque from stand-still and eliminating the need for a gearbox. Mechanically this makes the system simpler and much lighter. Depending on the acceleration given by the driver, a proportional amount of voltage reaches the motor and hence its speed varies in proportion to this applied voltage.

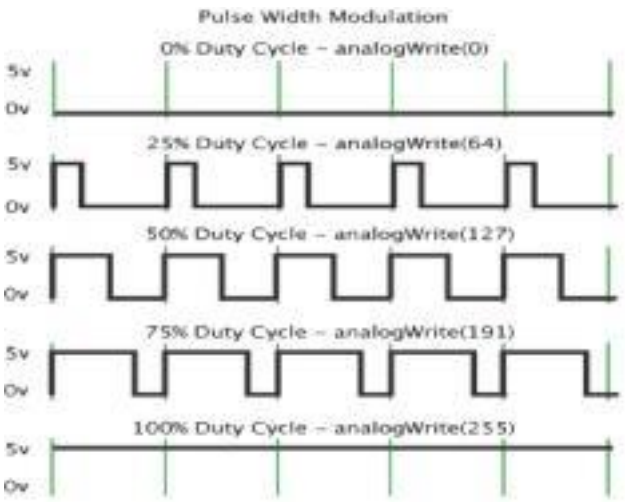

Fig -1: Pulse width modulated signal

To implement speed control mechanism in such systems, the most effective and efficient method is to use the concept of pulse width modulation (PWM). The PIC16F877A has two inbuilt CCP modules i.e. Capture/Compare/PWM. Based on the signal received from the sensors, these will be programmed to control the speed of the motor. By varying the amount of time the signal is on, the average of the signal approximates the level of the analog DC voltage needed to drive the motor at the same speed. This lets us vary the speed of the motor without changing the power supply voltage or current. In general, there are two different approaches to improve the induction motor efficiency especially under light-load conditions, namely, loss model The concept of pulse width modulation is illustrated in Fig-1.

The average DC voltage value for 0% duty cycle is zero; with 25% duty cycle the average value is 1.25V (25% of 5V). With 50% duty cycle the average value is 2.5V, and if the duty cycle is 75%, the average voltage is 3.75V and so on. The maximum duty cycle can be 100%, which is equivalent to a DC waveform. Thus by varying the pulse width, we can vary the average voltage across a DC motor and hence its speed. The application of so formed PWM pulses helps to control the speed of the vehicle. On the sudden detection of an obstacle, a complete halt of the vehicle is required. This becomes impossible for large electric vehicles due to its inertial effect. In order to provide a complete stop to the vehicle without any further forward motion, negative PWM pulses are being applied in similar way as the plugging braking of DC motors as shown in Fig-2. The negative pulses are applied at instant when the supply of positive pulses to the motor is cut. The period upto which negative pulses are applied is determined on the basis of speed sensor output. The PWM pulses can also be applied in intervals to act Anti-locking Braking system to avoid skidding of the vehicle. The PIC Microcontroller 16F877A act as the brain of the system that controls the DC motor based on the input from sensor. A keypad is provided to pre-set the distance at which the vehicle has to be stopped. Ultrasonic sensor measures the distance of the obstacle from the vehicle. Based on the input from the sensor, the microcontroller sends pwm pulses to the Motor driver which in turn drives the motor. The LCD screen displays the distance of obstacle from vehicle. A 12 volt battery is used as the power supply.

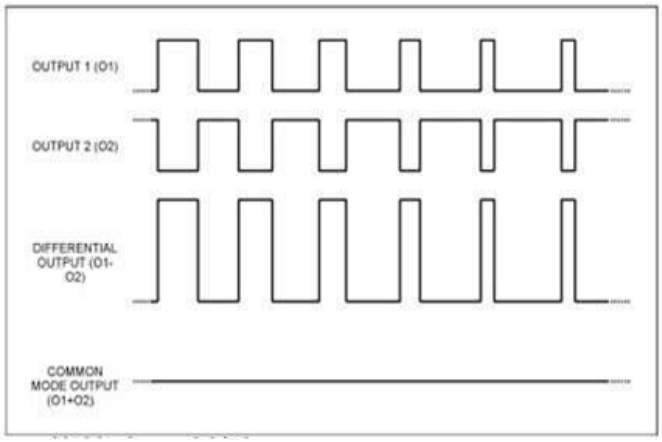

Fig -2: Pulse for sudden braking of vehicle

3. SYSTEM IMPLEMENTATION

The simulation of the project is done in Proteus. Program is written in C language within MPLAB software. The simulated view is shown in Fig-3 Instead of the obstacle, a resistor is included which gives reduced voltage to the ultrasonic sensor based on the resistance value in analogy to the distance of the obstacle from the sensor. Based on the distance value, pulses of different duty cycle are provided which is checked and verified by CRO. The circuit diagram and the final hardware images are given in the Fig-4&6.

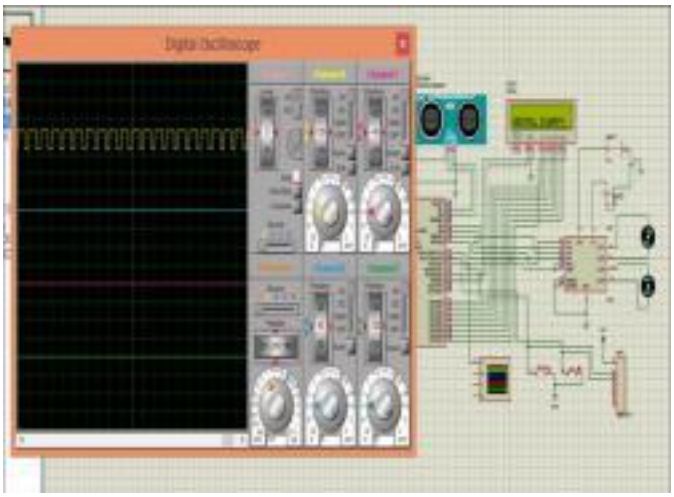

Fig -3: Simulation Model

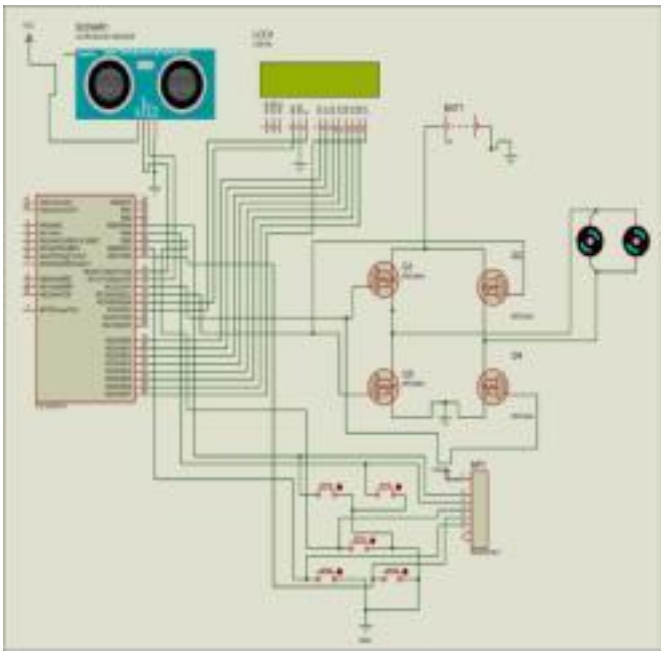

Fig -4: Circuit Diagram

Once velocity is found to be zero, distance is again measured. Pulses are applied in intervals till the change in distance ceases. This system acts as the ABS braking system.

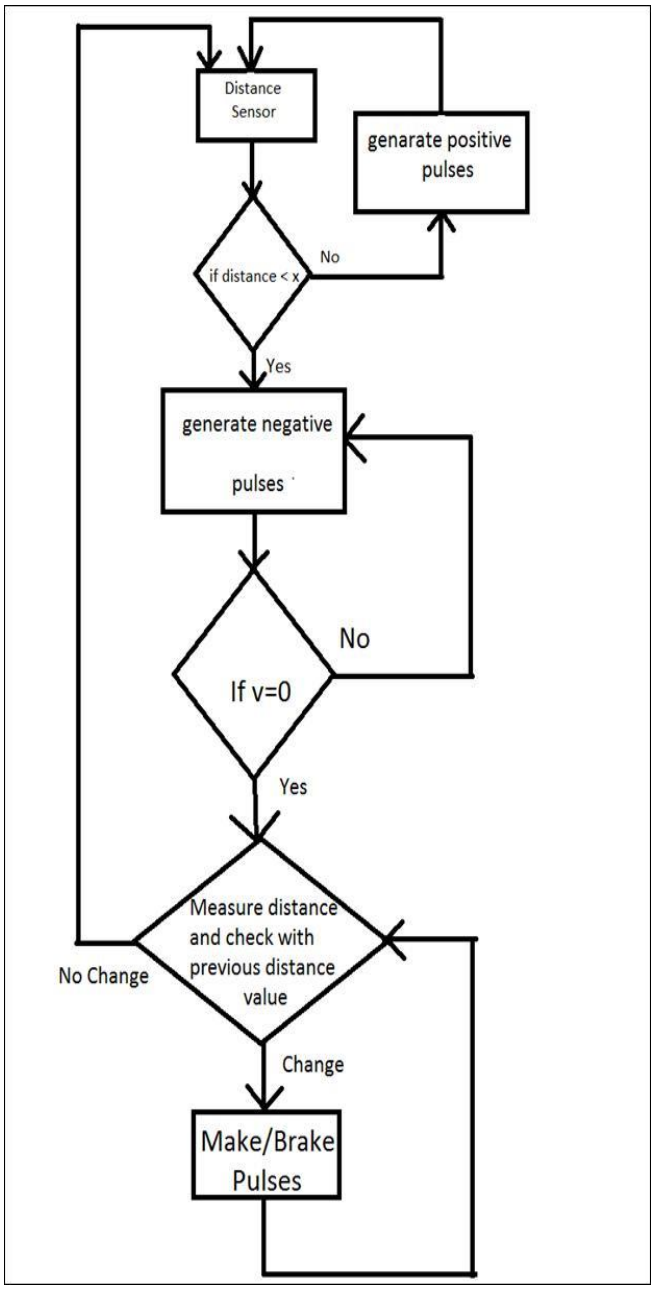

Fig -5: Flow chart of implementation

The project is expanded to accommodate a more efficient braking with the addition of ABS braking system. A speed sensor is added to check the speed of the vehicle after the reverse pulses are given. Sudden stop indicates zero velocity on the speed sensor. Further the distance is again measured to check any change in the distance value. A change in distance indicates skidding. Thus to avoid skidding, electric ABS system is activated by applying intermittent pulses. The flowchart indicating implementation is shown in Fig-5. If the distance is less than the preset value, negative pulses are applied till velocity reaches zero.

4. CONCLUSIONS

This project represents design and implementation of an Automatic Braking system indented to use in vehicles that can solve the problem where drivers may not brake manually, but vehicles can reduce speed automatically due to obstacles. It

proposed an efficient braking system for electric vehicles that avoids all the drawbacks of existing mechanical brakes. It discusses three algorithms namely, obstacle avoidance algorithm that detects the obstacle in front of the vehicle and brakes automatically, speed control algorithm that can accelerate or decelerate the vehicle according to the distance of vehicle from obstacle, braking algorithm where by sudden stopping of the vehicle is enabled. The project also incorporates the use of PWM pulses for Anti locking braking system .Through research presented, we propose an intelligent electrical system for accident prevention and making the world a much better and a safe place to live.

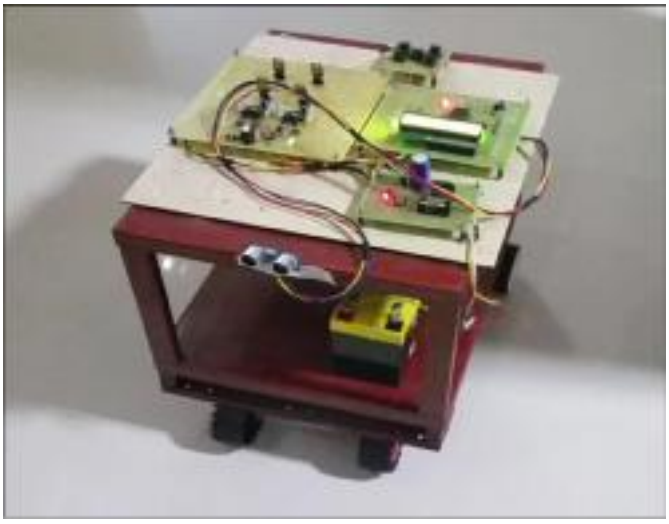

Fig -6: Hardware Model

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