INTELLIGENT BRAKING WITH SPEED REGULATION AND ALCOHOL DETECTION : USING BOTH SIMULATION AND MECHANICAL PROTOTYPE

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Abstract:

Recent years have seen a surge in purchasing of automobiles and with this increase within the number of automobiles has resulted in a very considerable increase in accident rates. Nowadays, vehicles are often equipped with active safety systems to cut back the likelihood of accidents, many of which occur within the urban environments. The premier systems currently include Antilock Braking Systems (ABS), Traction Control, and Stability Control. These safety systems assist the driver in various places however, they're keen about the manual operation of braking which is at risk of human error. due to this, there is a necessity to modify this mainstream braking system so on make the system works automatically. This paper considers the utilization of a smart controller to realize the above target. The prototype created using this method is tested and also the systemic scrutiny of the prototype was disbursed. The goal is to style and develop an embedded system supported by Arduino and several other sensors with high performance to make an automatic system is termed "INTELLIGENT BRAKING SYSTEM".

Key words: Automatic Braking, Sensor, Vehicle safety, Braking system, Alcohol detection, Speed Regulation.

I. INTRODUCTION

We use an ultrasonic sensor as the main actuator for this project to sense the incoming obstacles using the ultrasonic waves. It works by emitting and receiving ultrasonic waves in terms of analog input output. An ultrasonic receiver which may be a component that is a part of the sensor is additionally placed on the front portion of the vehicle ongoingly receiving a reflective ultrasonic wave signal. The reflected wave from the obstacle (if detected pulse) gives information about the presence of the article. at that instant, it stops and moves backward and detects an obstacle in another direction, and moves forward in a direction where it didn't detect any object without crashing with the obstacle. The microcontroller is utilized to control the Speed regulation and braking of the vehicle supporting the reflected wave detected pulse information to automatically overcome and stop the vehicle. Braking systems of vehicles were always specified because the very best factor concerning safety matters. Improper braking of the vehicles may cause substantial accidents due to fairly longer stopping distances and better energy output of brakes particularly in the case of car combinations. The research studies for the proposed system clearly explains that the Ultrasonic sensor and microcontroller action plays an important role in determining intelligent braking torque generated by brake actuation assembly. The new Braking System (Intelligent Braking System) is to be introduced in vehicles providing rapid brake response and release for every single wheel, therefore, warranting safety. The extremely rapid quantity provided by the electronic control could also be used for crucially Shortening the braking distance by introducing advanced control of braking system operation.

This new braking system encompasses plenty of potential applications, especially in developed countries where research on smart and intelligent vehicles and smart highways is receiving adequate attention. The leading popular Systems like Antilock Braking Systems (ABS), Traction Control, and Stability Control employ different types of sensors to constantly monitor the conditions of the vehicle,

and respond in an emergency situation. The reflected wave (detected pulse) gives the distance of gap between the obstacle and also the vehicle.

Then a Microcontroller is used to manage the speed of the vehicle supported by the detection pulse information to push the foot lever and apply brake to the vehicle stupendously for safe braking.

II. LITERATURE REVIEW

There are considerable advances in braking systems in recent years. Engineers have proposed several improvements. Long range radar system was developed for implementations where automatic braking is applied in response to detection of a collision risk where an awfully high probability of detection is within the course of an extremely low level of false alarms. A brake strategy for an automatic parking system of the car has proposed a brake controller which works with the automated parking system and makes the tactic of parking smooth and stable. An autonomous antilock braking system (ABS) system which can take over the traction control of the vehicle is developed for a four-wheel vehicle.

During this paper, a replacement approach has been proposed for easy and effective monitoring, modelling, prediction, and control of the braking process i.e. the brake performance during a braking cycle. The context-based control of the hydraulic brakes actuation pressure was used for improving the dynamic control of the braking process versus the influence of the previous and current values of the hydraulic brakes actuation pressure, the vehicle speed, and also the brake interface temperature.

A. Existing Safety systems:

The existing approaches to preventing accidents are:

The Automobile company Honda's current idea of anti-lock braking helps the rider get a hassle-free braking experience is muddy and watery surfaces by applying a distributed braking and prevents skidding and wheel locking.

While Automobile company Volvo launched a new vehicle which was equipped with laser-assisted braking system. This system is capable enough to sense a collision up to 50 m/s and apply brakes automatically.

B. Drawbacks in the existing approaches:

- Anti-locking System can only help if the rider applies it at right time manually and maintains the gap calculations. Anti-locking system has its braking distance which is shorter than the conventional braking system.
- Moreover, most of the commuter bikes in India don't have anti-locking system because of its expensive price range.

III. METHODOLOGY

This new intelligent Braking system includes an ultrasonic wave emitter provided on the front portion of a car producing and emitting ultrasonic waves frontward with a fixed predetermined distance. An ultrasonic receiver is additionally placed on the front portion of the car ongoingly receiving a reflective ultrasonic wave signal.

The reflected wave (detected pulse) gives the space between the obstacle and also the vehicle. The microcontroller is used to manage the speed of the vehicle supporting the detection pulse information to send the signal to the motor driver and apply the brake to the car stupendously for safety purposes. The extremely rapid latent period provided by the electronic control is employed for crucially shortening the braking distance by introducing advanced control of braking system operation.

The control of an economic vehicle's braking system operation is alleged not only to vehicle speed but also to lateral acceleration together with the yaw moment control and significantly reducing the probabilities of the vehicle rolling over.

Since sound is produced through vibrations, we can say that the sound is essentially a mechanical wave traveling through the mediums, which might be a solid, liquid, or gas. Sound waves can travel through the mediums with a particular velocity looking at the medium of propagation.

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The sound could also be a mechanical wave traveling through the mediums, which might be a solid, liquid, or gas. Sound waves can travel through the mediums with a selected velocity using different kinds of medium of propagation. The sound waves that travel with medium frequency to high frequency reflect from the wall boundaries and produce characteristic echos. For this purpose, the laws of physics which are indicating the propagation of sound waves through solid materials are used since ultrasonic sensors use sound instead of light for detection.

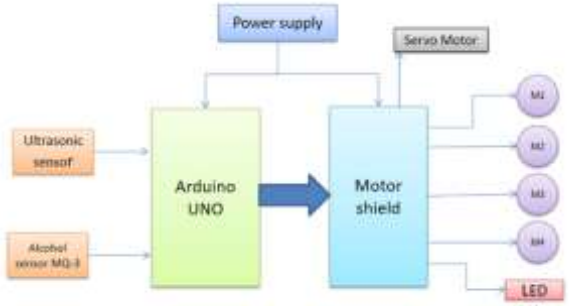

Fig.1. Block Diagram of Intelligent braking system

Factors taken into Consideration

Due to the many variables present which can alter the input and output as well as the sensor working and calculation of microcontroller in different scenarios, it gets increasingly difficult to stick to a proper way of research while ignoring the rest of the varying factors, hence, in this project we only consider the following factors as the prime variables.

Factors contemplated for the system design are:

- Total Stopping Distance (Braking Distance)
- Distance of said obstacle in front of vehicle.

A.1 Total Stopping Distance (Braking Distance)

Total stopping distance is the addition of reaction distance and the braking distance. But the prime factor in this case is the braking distance. Braking distance can be calculated by the following formula i.e.,

Braking Distance = (V^2) / 2μg (meter)

Where,

V= Velocity of the vehicle (m/s)

μ = Coefficient of friction, Assume = 0.8

g = Acceleration due to gravity = 9.81(m/s^2)

Here for Coefficient of friction μ, we assume the tires are new without much wear and tear and with clean, dry and straight leveled roads.

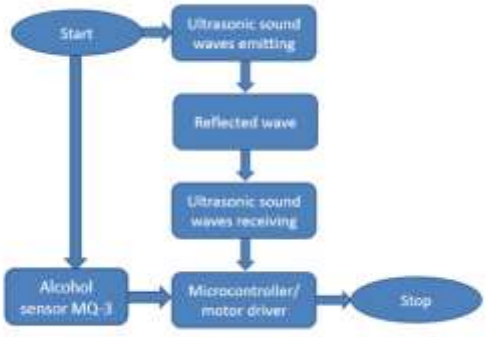

Fig.2. Workflow of the project idea

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Table-1

sl.no	Velocity(kmph)	Distance(m)
1	05	0.12
2	10	0.6617
3	20	2.2472
4	30	5.0563
5	40	8.9891
6	50	12.28
7	60	17.69

Stopping distance for Different Speeds of vehicle

Table.1 Stopping distance for different speeds using the formula above.

A.2 Distance of said obstacle in front of vehicle

The gap distance of any obstacle, a parked or a moving vehicle or a road block from the vehicle is sensed using an ultrasonic sensor and it is fed to microcontroller. To note that we could also use Optical sensor for the same situation and output.

Speed Regulation-

- In this project, Speed Regulation is an important feature due to which the Motor driver can show its functions properly.
- Main component Motor Driver/Servo shield is used in this project which can connect to two servo motors and up to four motor connectors for DC or stepper motors.
- The shield contains two motor driver IC(L293D) and one shift register(74HC595). The shift register expands 3 pins of the Arduino Board to 8 pins to control the direction of the motor drivers. The output enables the Motor Driver is directly connected to the PWM outputs of the Arduino.
- By using the PWM, motor control for Speed regulation is achieved.

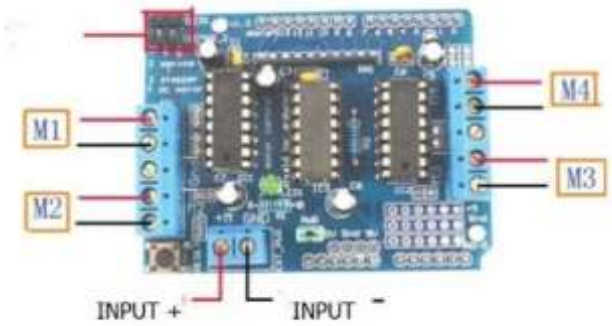

Fig.3. Motor Driver connection

Alcohol Detection-

- The Gas sensor that senses the alcohol concentration is placed near the driver seating position along with the whole system where it senses the value of alcohol concentration in terms of analog data.
- This value is then sent to the Analog to Digital converter also called adc that is connected internally to the microcontroller. Microcontroller only takes digital values, hence, this ADC is required to convert the analog values to digital values.

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- If the sensed alcohol level is beyond the limit set in the program, then the system won't start as instructed in the code.
- The sensor takes 5V power supply and has high sensitivity and fast response time, providing Analog output based on alcohol concentration.

Fig.4. Alcohol sensor

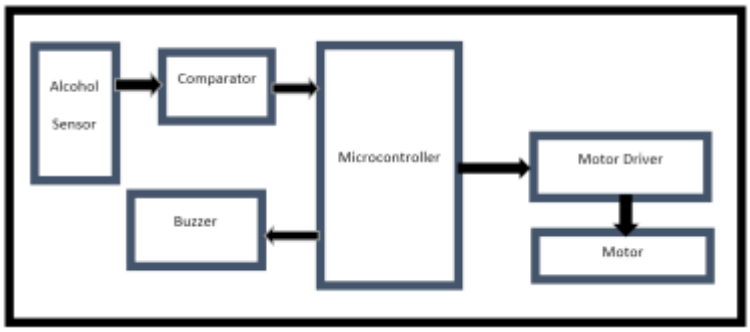

Fig.5. Block diagram for Alcohol detection

IV. SYSTEM ARCHITECTURE

The Design and the architecture of this project is mainly dependent on the components used as well as the tools and firmware used to program the code and simulate the whole project idea to understand and visualize its working in a detailed manner to create an appropriate prototype.

The Code written takes into account the various real-life factors which oppose or change the variables the are pre-conceived in the planning stage of the project idea.
The Main components used to assemble and make this project work are,

- Ultrasonic Sensor
- Motor Driver
- Arduino UNO
- DC Batteries (18650)
- Motors
- Alcohol Sensor

Connection of Circuit
Intelligent Braking system and Speed Regulation -

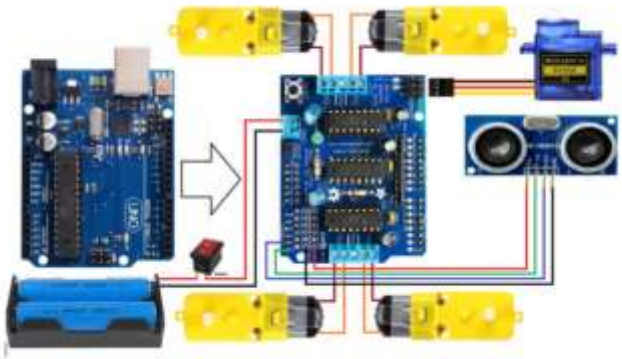

Fig.6. Basic circuit connection to components

Alcohol detection using Gas Sensor -
The connection for this alcohol detection system can be integrated into out main basic circuit connection.
All we have to connect is the Supply pin of gas sensor to the Arduino board supply and similarly connect the digital output, analog output and ground pins to the Arduino board through the motor shield that is connected above the Arduino board.

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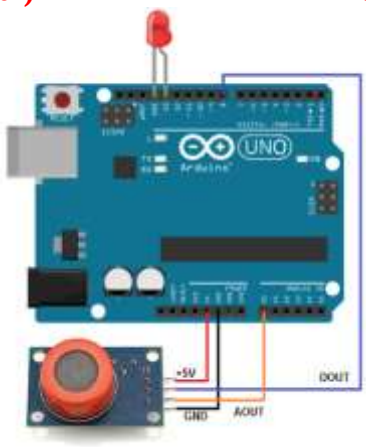

Fig.7. Circuit connection of Alcohol sensor to Arduino

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