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An Accident Prevention Technique For Speed Bumper Detection Through IR Sensor And Motor Speed Control Using Timer

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Abstract : *A method of preventing an accident using a technology is called ultrasonic. This project is about making cars more intelligent and interactive which may notify or resist user under unacceptable conditions. This project focuses on building a user-friendly vehicle that specializes in detecting intrusions besides doing close range obstacle detection especially bumper in road. night when sudden bumper can be found in highway and driver cannot detect that due to darkness our proposed system initially generate a beep alarm which can make alert the driver for avoiding accident. Automobile safety can be improved by anticipating a crash before it occurs and thereby providing additional time to deploy safety technologies. Warnings can be like buzzer if the driver is approaching a pothole or any obstruction, driver may be warned in advanced regarding what the road entails. Not only that the speed of motor attached with wheel can be controlled automatically after detecting the bumper. Hence accident can be prevented during the happy journey. It will perform the function with the help of infrared sensors more specifically proximity sensor. The project's ultimate aim thus finalized as, one to build a general, easy-to-use and versatile system that can prevent fatal accidents.*

Keywords: *Ultrasonic, Obstacle detection, Edge detection, infrared sensors, proximity sensor.*

I. Introduction

Speed bumps (or speed bumpers) are the common name for a family of traffic calming devices that use vertical deflection to slow motor-vehicle traffic in order to improve safety conditions. Variations include the speed hump (or speed ramp), speed cushion, and speed table. The use of vertical deflection devices is widespread around the world, and they are most commonly found where vehicle speeds are statutorily mandated to be low, usually 40 km/h (25 mph), or 8 to 16 km/h (5.0 to 9.9 mph) in car parks. Disadvantage of these speed bumps are: (a) Slow response time of emergency vehicles (b) May divert traffic to parallel residential streets (c)Possibility of increased noise and pollution for residents living immediately adjacent to the speed bumps.(d)Can cause damage to some vehicles, increase traffic noise. Most of the accidents in India can be accounted by two main reasons first being the dangerous road conditions and second main reason being driver distraction. Vehicles will require new exterior pre-collision detecting sensors to create an electronic awareness at the time of root travelling. Pre- collision detecting sensing may well have the most impact in reducing injuries from night-time accidents involving impaired drivers. However, the advanced safety features enabled by Pre-collision detecting sensing will provide a significant benefit in all cases of lack of street light, foggy weather, or driver distraction. We can use bumper detection technology with the help of proximity sensor as well as infrared. A low range obstacle like bumper can be detected by the vehicle using its infrared sensing techniques implemented in front of the chassis of the vehicle and it can be executed by arduino based microcontroller system. We can also detect sudden change of flat surface and avoid the accident from the edge of drain, river etc.

II. Working Principle Of Infrared Sensor

IR sensor basically consist an IR LED and a Photodiode, this pair is generally **called** IR pair **or** Photo **coupler**. IR sensor work on the principal in which IR LED emits IR radiation and Photodiode sense that IR radiation. Photodiode resistance changes according to the amount of IR radiation falling on it, hence the voltage drop across it also changes and by using the voltage comparator (like LM358) we can sense the voltage change and generate the output accordingly. The placing of IR LED and Photodiode can be done in two ways: Direct and Indirect. In Direct incidence**,** IR LED and photodiode are kept in front of one another according to the figure1, so that IR radiation can directly falls on photodiode. If we place any object between them, then it stops the falling of IR light on photodiode.

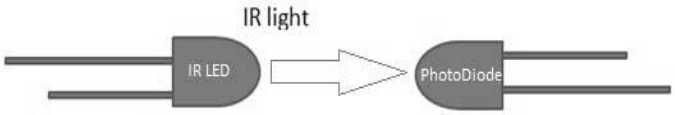


Fig1. IR LED and Photodiode

And in **Indirect Incidence**, both the IR LED and Photo diode are placed in parallel (side by side according to figure 2), facing both in same direction. In that fashion, when a object is kept in front of IR pair, the IR light gets reflected by the object and gets absorbed by photodiode. Note that object shouldn't be black as it will absorb all the IR light, instead of reflect. Generally IR pair is placed in this fashion in IR sensor Module.

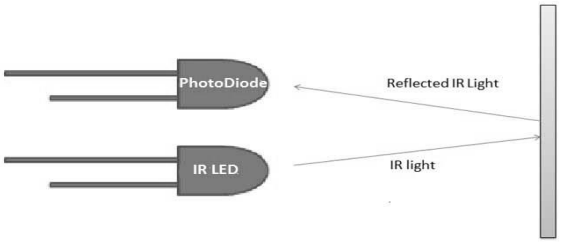
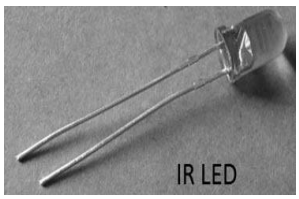


Fig2. Reflection between Diode and LED

III. IR Module Component Set

(a) IR LED :

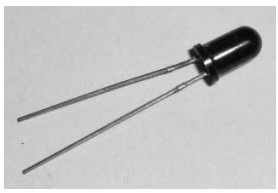
IR LED emits light, in the range of Infrared frequency. IR light is invisible to us as its wavelength (700nm – 1mm) is much higher than the visible light range. Everything which produce heat, emits infrared like for example our human body. Infrared have the same properties as visible light, like it can be focused, reflected and polarised like visible light.



IR LED looks like a normal LED and also operates like a normal LED, it consumes 20mA current and 3vots power. IR LEDs have light emitting angle of approx. 20-60 degree and range of approx.

(b) Photodiode:

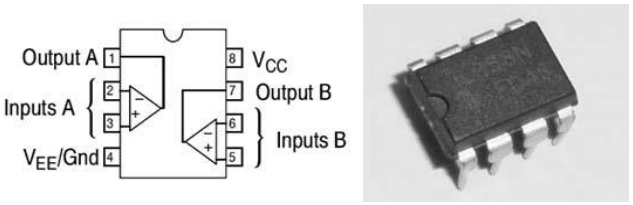
Photodiode is considered as Light dependent Resistor (LDR), means it has very High resistance in absence of light and become low when light falls on it. Photodiode is a semiconductor which has a P-N junction**,** operated in Reverse Bias**,** means it start conducting the current in reverse direction when Light falls on it, and the amount of current flow is proportional to the amount of Light. This property makes it useful for IR detection.



(c) LM358:

LM358 is an operational amplifier (Op-Amp) and in this circuit we are using it as a voltage comparator**.** The LM358 has two independent voltage comparators inside it, which can be powered by single PIN, so we can use the single IC to build two IR sensor modules. We have used only one comparator here, which have inputs at PIN 2 & 3 and output at PIN 1. Voltage comparator has two inputs; one is inverting input and second is non-

inverting input (PIN 2 and 3 in LM358). When voltage at non-inverting input (+) is higher than the voltage at inverting input (-), then the output of comparator (PIN 1) is High. And if the voltage of inverting input (-) is Higher than non-inverting end (+), then output is LOW.



IV. Ir Sensor Module

V. **Components :**

(a) IR pair (IR LED and Photodiode),(b) IC LM358 ,(c)Resistor 100, 10k, 330 ohm, (d) Variable resistor – 10k, (e) LED

VI. Circuit diagram :

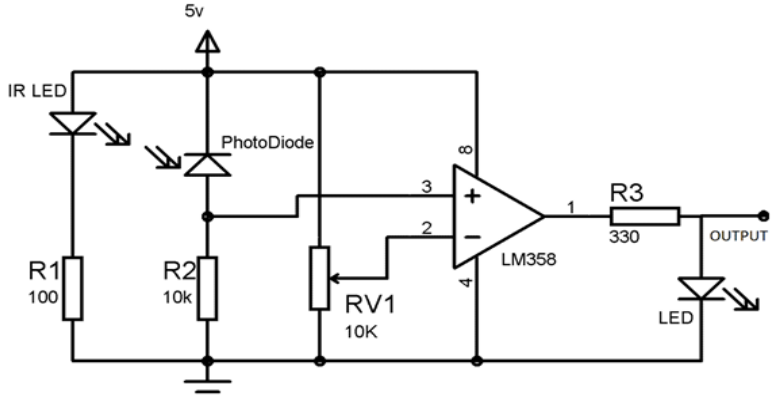


Fig-3: Circuit diagram of IR Sensor Module

VII. **Activities:** Photo diode is connected in reverse bias, inverting end of LM358 (PIN 2) is connected to the variable resistor, to adjust the sensitivity of the sensor. And non-inverting end (PIN 3) is connected to the junction of photodiode and a resistor. When we turn ON the circuit there is no IR radiation towards photodiode and the Output of the comparator is LOW. When we take some object (not black) in front of IR pair, then IR emitted by IR LED is reflected by the object and absorbed by the photodiode. Now when reflected IR falls on Photodiode, the voltage across photodiode drops, and the voltage across series resistor R2 increases. When the voltage at Resistor R2 (which is connected to the non-inverting end of comparator) gets higher than the voltage at inverting end, then the output becomes HIGH and LED turns ON. Voltage at inverting end, which is also called **Threshold Voltage**, can be set by rotating the variable resistor's knob. Higher the voltage at inverting end (-), less sensitive the sensor and Lower the voltage at inverting end (-), more sensitive the sensor.

V. Proposed Bumper Detection And Motor Control Technique

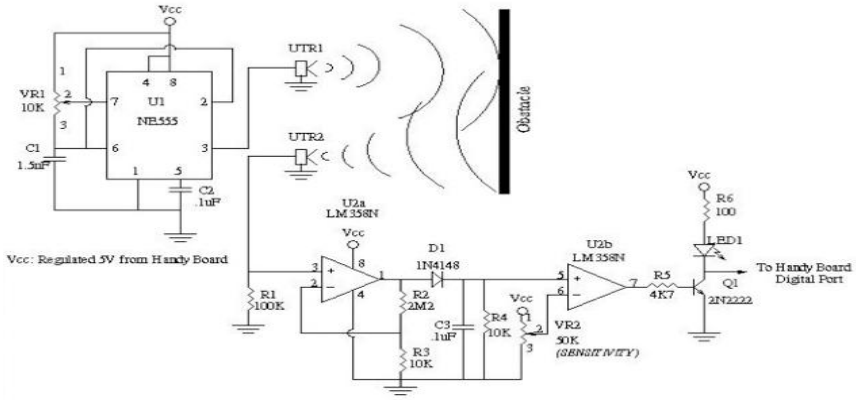
(a) Bumper Detection technique :

This circuit describe a simple bumper detection which can easily make in your homes because it does not contains any complex digital circuitry .This is an intelligent technique which will automatically detect the presence of bumper in its path and change the direction of motion accordingly.

Components:

U1 – NE555 Timer, U2 – LM356N Single supply op-amp, Q1 – 2N2222 bipolar transistor, D1 – 1N4148 silicone diode LED1 – Light Emitting Diode, red (All resistors are 114 Watt, 5%) R1 – 100K ohm, R2 – 2.2 Megaohm, R3, R4 – 10K ohm, R5 – 4.7 ohm, R6 – 100 ohm, VR1 – 10K ohm multi-torn pot, VR2 – 50K ohm multi-torn pot, C1 – 1.5 nF ceramic, C2-C5 – 1nF ceramic UTR1, UTR2 – 40 KHz Ultrasonic Transducer Pair

Circuit Diagram:



(b) Motor Speed control after detecting bumper:

Motor Speed Control Circuit is primarily a 555IC based PWM (Pulse Width Modulation) circuit developed to get variable voltage over constant voltage. The method of PWM is explained here. Consider a simple circuit as shown in figure below.

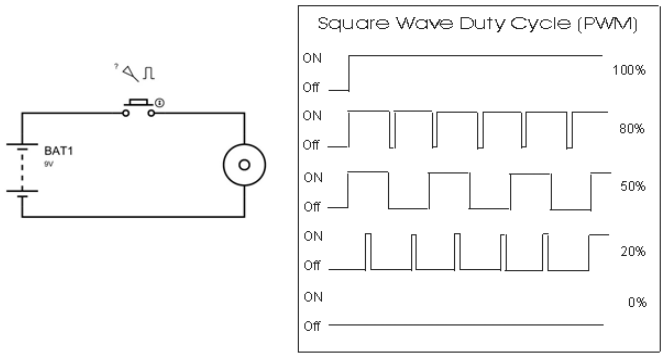


Fig-5 Wave Cycle of motor speed

If the button is pressed in the figure-5, then the motor will start rotating and it will be in motion until the button is pressed. This pressing is continuous and is represented in the first wave of figure-5. If, for a case, consider button is pressed for 8ms and opened for 2ms over a cycle of 10ms, during this case the motor will not experience the complete 9V battery voltage as the button is pressed only for 8ms, so the RMS terminal voltage across the motor will be around 7V. Due to this reduced RMS voltage the motor will rotate but at a reduced speed. Now the average turn on over a period of 10ms = Turn ON time/ (Turn ON time + Turn OFF time), this is called duty cycle and is of 80% (8/(8+2)).

In second and third cases the button is pressed even lesser time compared to first case. Because of this, the RMS terminal voltage at the motor terminals gets even decreased further. Due to this reduced voltage the motor speed even decreases further. This decreases in speed with duty cycle continuous to happen until a point, where the motor terminal voltage will not be sufficient to turn the motor.

So by this we can conclude the PWM can be used to vary the motor speed.

Before going further we need to discuss the H-BRIDGE. Now this circuit has mainly two functions, first is **to** drive a DC motor from low power control signals and the other is to change the direction of rotation of DC motor.

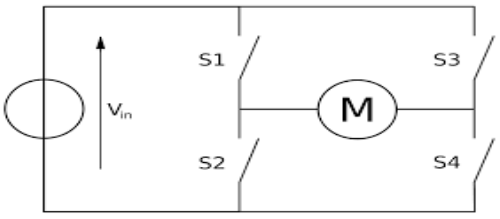


Fig-6 Button is pressed even greater time compared to second case

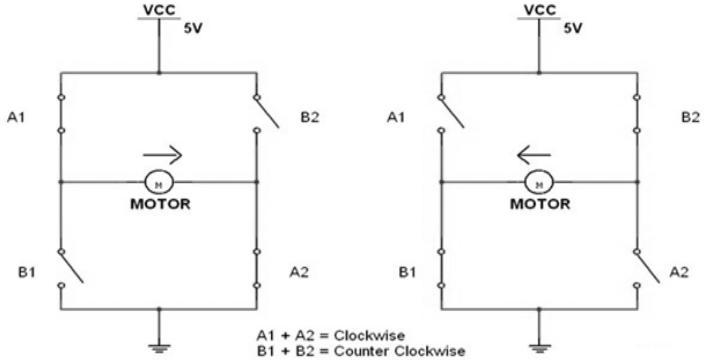


Fig-7: Button is pressed even lesser time compared to first case

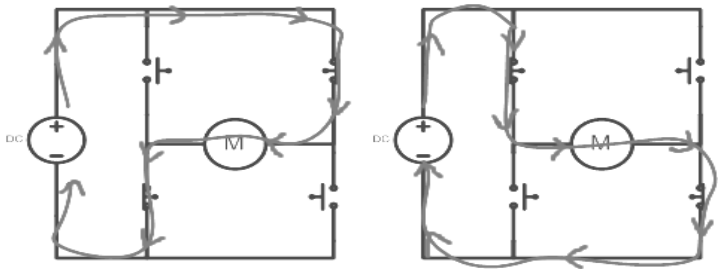


Fig-8: H-Bridge diagram

We all know that for a DC motor, to change the direction of rotation, we need to change the polarities of supply voltage of motor. So to change the polarities we use H-bridge. Now in above figure1 we have fours switches. As shown in figure7, for the motor to rotate A1 and A2 are closed. Because of this, current flows through the motor from right to left, as shown in 2nd part of figure-8. For now consider the motor rotates clockwise direction. Now if the switches A1 and A2 are opened, B1 and B2 are closed. The current through the motor flows from left to right as shown in 1st part of figure 8. This direction of current flow is opposite to the first one and so we see an opposite potential at motor terminal to the first one, so the motor rotates anti clock wise. This is how an H-BRIDGE works. However low power motors can be driven by a H-BRIDGE IC L293D.

L293D is an H-BRIDGE IC designed for driving low power DC motors and is shown in figure. This IC consists two h-bridges and so it can drive two DC motors. So this IC can be used to drive robot's motors from the signals of microcontroller.

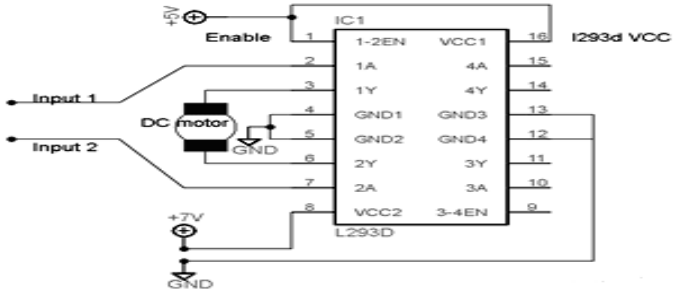


Fig-9 L293D with 2-line input

Now as discussed before this IC has ability to change the direction of rotation of DC motor. This is achieved by controlling the voltage levels at INPUT1 and INPUT2.

Enable Pin	Input Pin 1	Input Pin 2	Motor Direction
High	Low	High	Turn Right
High	High	Low	Turn Left
High	Low	Low	Stop
High	High	High	Stop

So as shown in above figure, for clockwise rotation 2A should be high and 1A should be low. Similarly for anti clockwise 1A should be high and 2A should be low.

Circuit Components

(a)+9v power supply, (b) Small DC motor, (c) 555 Timer IC, (d) 1K, 100R resistors (e) L293D IC (f) 100K - 220K preset or pot , (g) IN4148 or IN4047 x 2 (h)10nF or 22nF capacitor (i) Switch

Circuit Diagram:

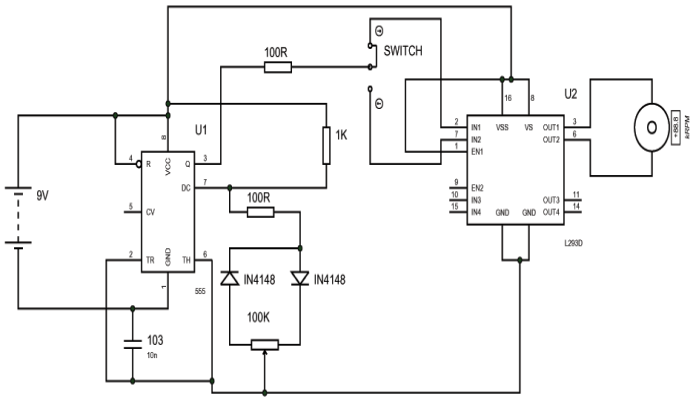


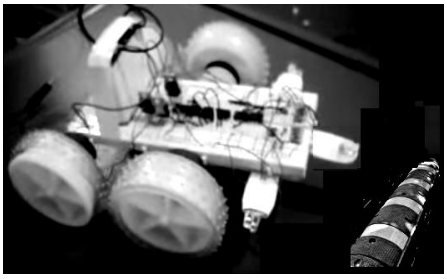
Fig-9: Circuit diagram

The circuit is connected in breadboard as per the DC motor speed control circuit diagram shown above. The pot here is used to adjust the speed of motor. The switch is to change the direction of rotation of motor. The capacitor here must not of a fixed value; the user can experiment with it for a right one.

Working Procedure:

When power is supplied, 555 TIMER generates PWM signal with a duty ratio based on the pot resistance ratio. Because of the pot and the diode pair, here the capacitor (which triggers the output) must charge and discharge through a different set of resistance and because of this, the capacitor takes a different time to charge and discharge. Since the output will be high when the capacitor is charging and is low when the capacitor is discharging, we get a difference in high output and low output times, and so the PWM. This PWM of timer is fed to the signal pin of L239D h-bridge to drive the DC motor. With the varying PWM ratio we get varying RMS terminal voltage and so the speed. To change the direction of rotation the PWM of timer is connected to the second signal pin.

I. Experiments And Results



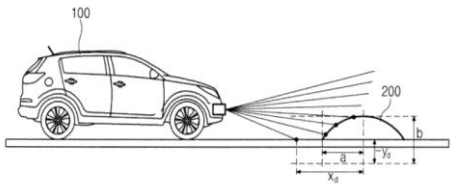
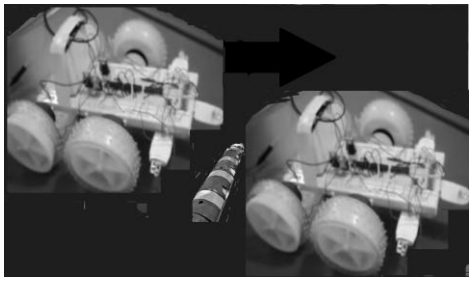


Fig-10: When the speed-bumper occurs, the sensor get senses and motor get stopped for 10 seconds. Alarm beeped and then car moves forward with low speed.



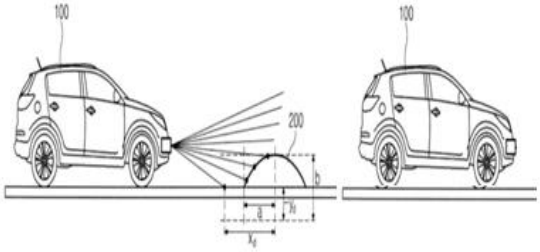


Fig-11: Speed can be controlled automatically after rolling over the speed bumper.

VI. CONCLUSION

Ultimate aim of our proposed model is to build a general, easy-to-use and versatile system that can prevent fatal accidents in road at the time of journey. Driving models are needed by many researchers. Intelligent vehicle designers need them to make driver aids that work in dynamic traffic situations. Through our bumper detection and alarming system we are trying to build a user-friendly vehicle that specializes in detecting intrusions besides doing close range bumper like obstacle detection in road. Based on aforesaid criteria discussed throughout our paper we developed a accident prevention technique by using IR sensor implemented in a car which detect a sudden bumper in highway and generate a beep alarm which can make alert the driver for avoiding accident.

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