Fabrication of Intelligent Braking System

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Abstract - *Recent years have seen a surge in purchasing of automobiles and with this increase in the number of automobiles have resulted in a considerable increase in accident rates. Most of the accident occurs due to the delay of the driver to hit the brake, so in this project work a braking system is proposed such that when it is active it can apply brake on its own if there is an impending delay on the driver's side depending upon the object sensed by the ultrasonic sensor and speed of vehicle. The ultrasonic sensor receives the reflected ultrasonic 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 this information. A prototype was created and the structural analysis of the prototype was performed.*

***Key Words*:** Automatic braking, Ultrasonic sensor, Arduino processor, Prototype fabrication and testing.

1. INTRODUCTION

Braking systems of commercial vehicles were always given the highest importance concerning safety issues and in particular active safety. Inappropriate braking of these vehicles may cause heavy accidents due to relatively longer stopping distances and higher energy output of brakes. The rapid response time provided by the electronic control can be used for crucially shortening the braking distance by introducing advanced control of braking systemoperation.

Intelligent braking system has a lot of potential applications especially in developed countries where research on smart vehicle and intelligent highway are receiving ample attention. The system when integrated with other subsystems like automatic traction control system, intelligent throttle system, and auto cruise system, etc. will result in smart vehicle maneuver. The driver at the end of the day will become the passenger, safety accorded the highest priority and the journey will be optimized in term of time duration, cost, efficiency and comfortability.The impact of such design and development will cater for the need of contemporary society that aspires quality drive as well as to accommodate the advancement of technology especially in the area of smart sensor.

The proposed intelligent braking system uses a pneumatic brake system which includes an ultrasonic wave emitter provided on the front portion of the prototype producing and emitting ultrasonic waves frontward in a predetermined distance. The reflected wave (detected pulse) gives the distance between the obstacle and vehicle, also speed of vehicle is noted. The microcontroller is used to control the braking of the vehicle based on this information.

2. LITERATURE REVIEW

Braking system with Automatic Pneumatic Bumper. (Thepade,N,et al.,2016) This journal describes an idea to reduce impact on four wheelers during emergency conditions where a collision is imminent. The journal suggests that four wheelers should incorporate an extended bumper to absorb the impact shock. The bumper is extended using pneumatic system which receives input from an electronic proximity measuring system.

Stability Control of Vehicle during emergency braking. (Chen Q, et al., 2014) The journal describes the skidding of automobile tires during emergency braking and the need to apply brakes as in pulses or in a gradually increasing braking force rather than a sudden press.

Research on adaptive cruise control. (Chengwi.S , et al.,2016) The journal describes sharing information between automobiles while they are in motion in order to reduce accidents. The communication could be made possible through proximity sensors and Bluetooth devices. Automobiles when comes within the range of proximity sensors information regarding their speed and vehicle conditions can be shared with each other resulting in an efficient travelling with minimal risk of accidents.

Brake reactions of distracted drivers to pedestrian forward collision systems.(Nils L ,2017) This journal describesthatanaudioandvisualwarningwithanadded

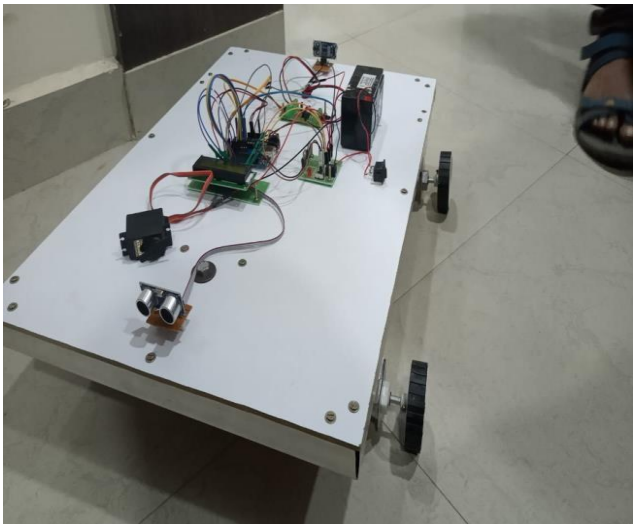
pulse is most effective in preventing collisions thereby reducing accident chances. If a distracted driver does not see a pedestrian beep sounds along with red warning lights are shown to the driver reminding him to look for the pedestrian and applybrakes.

Distance measuring by Ultrasonic sensor . (Koval.L , et al.,2016) The journal describes active and passive ultrasonic sounds and the use of passive ultrasonic for distance measurement. It is seen that ultrasonic sensor has good accuracy . Ultrasonic sensor performs well under rainy and humid conditions unlike other proximity sensors

3. METHODOLOGY

The Intelligent braking system uses ultrasonic sensor mounted on the front end of the automobile to detect the distances of obstructions from the automobile. This signal input along with the speedometer input is send to the microcontroller. Microcontroller uses the algorithm provided and the two information signals to decide whether to take braking action or not if the driver does not apply. Brakes are applied by controlling a solenoid valve which actuate pneumaticpistons.

The whole system consists of a prototype of a vehicle which consists of a chassis made of hollow GI square tubes and four tyres of the scooter model Activa attached to it. A 12V motor of 30 rpm drives the system. The electronic system consists of a microcontroller, a small display unit and an ultrasonic sensor which senses the proximity of an object and the microcontroller gives out a signal to the solenoid valve to actuate the pistons thus a braking force is applied.

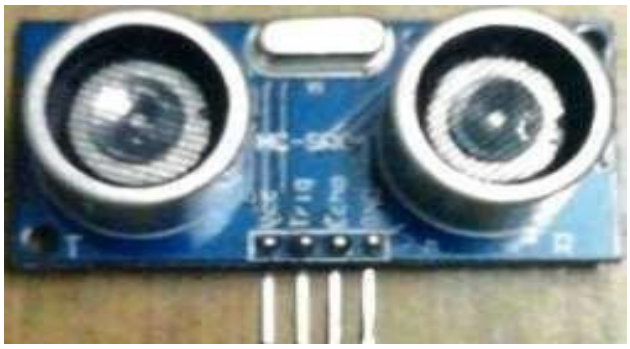


First design made using Creo Parametric 2.0

4.PRINCIPAL COMPONENTS OF INTELLIGENTBRAKING SYSTEM

4.1 ULTRASONICSENSOR

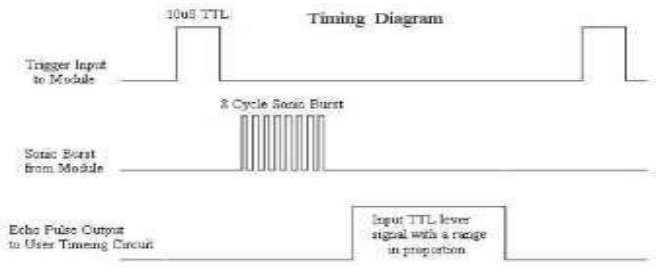
Ultrasonic ranging and detecting devices make use of high-frequency sound waves to detect the presence of an object and its range. These systems either measure the echo reflection of the sound waves from objects or detect the interruption of the sound beam as the objects pass between the transmitter and receiver. An ultrasonic sensor typically utilizes a transducerthatproducesanelectricaloutputpulseinresponsetothereceivedultrasonicenergy.Insuchcase, thehorizontalapertureanglemustbeatleast8degreesforanintervehicledistanceof75meter.Theverticalapertureisfixedtobe1degreeandispositionedinsuchawaytoavoidfaultreading due to theroadconditions.



TIMING DIAGRAM

diagram is shown below. You only need to supply a short 10Us pulse to the trigger input to start the ranging,andthenthemodulewillsendoutan8cycleburstofultrasoundat40kHzandraiseits echo. The Echo is a distance object that is pulse width and the range in proportion .You can calculate the range through the time interval between sending trigger signal and receiving echo signal. Formula: uS / 58 = Centimetres or uS / 148 =inch; or: the range = high level time * velocity (340M/S)/2;wesuggesttouseover60msmeasurementcycle,inordertopreventtriggersignalto the echo signal.

Ultrasonic ranging module HC - SR04 provides 2cm - 450cm non-contact measurement function,therangingaccuracycanreachto3mm.Themodulesincludesultrasonictransmitters, receiver and control circuit.



PROCESSOR (ARDUINO UNO)

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/outputpins(ofwhich6canbeusedasPWMoutputs),6an aloginputs,a16MHzceramic resonator,aUSBconnection,apowerjack,anICSPheader,and aresetbutton.Itcontains everything needed to support the microcontroller; simply connect it to a computer with a

USB cableorpoweritwithaAC-to-DCadapterorbatterytogetstarted."Uno"meansoneinItalianan d *is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the* reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards,andthereferencemodelforthe

4.4 Welding

Welding is a process for joining similar metals. Welding joins metals by melting and fusing 1, the base metals being joined and 2, the filler metal applied. Welding employs pinpointed, localized heat input. Most welding involves ferrous-based metals such as steel and stainless steel. Weld joints are usually stronger than or as strong as the base metals beingjoined.

5. MANUFACTURING

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are then modified through manufacturing processes to become the required part. Manufacturing processes can include treating (such as heat treating or coating), machining, or reshaping the material. The manufacturing process also includes tests and checks for quality assurance during or after the manufacturing, and planning the production process prior to manufacturing.

5.1 Metalcutting

Metal cutting or machining is the process of by removing unwanted material from a block of metal in the form of chips. Cutting processes work by causing fracture of the material that is processed. Usually, the portion that is fractured away is in small sized pieces, called chips. Common cutting processes include sawing, shaping (or planning), broaching, drilling, grinding, turning and milling

5.2 Sawing

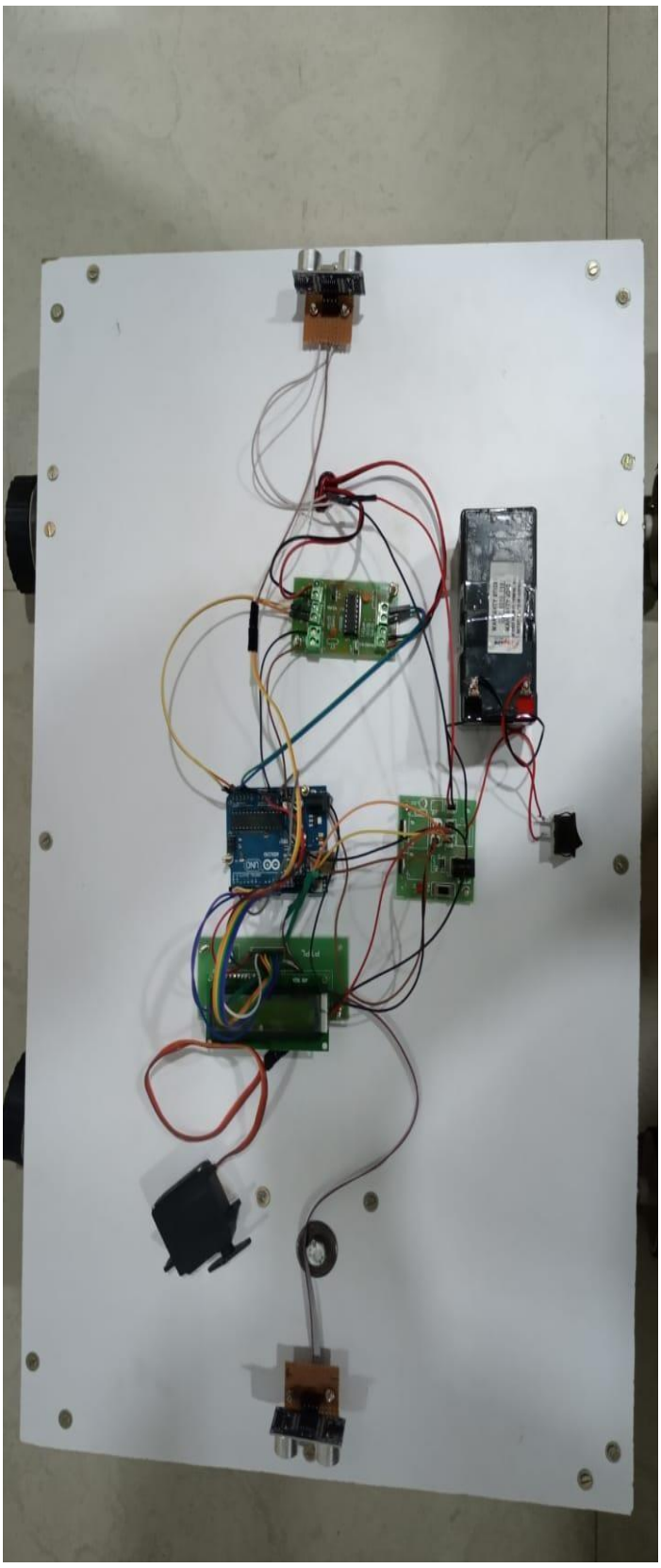
Cold saws are saws that make use of a circular saw blade to cut through various types of metal, including sheet metal. The name of the saw has to do with the action that takes place during the cutting process, which manages to keep both the metal and the blade from becoming toohot.

5.3 Drilling

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit is pressed against the workpiece and rotated at rates from hundreds to thousands of revolutions per minute.This forces the cutting edge against the workpiece, cutting off chips (swarf) from the hole as it is drilled.

5.4 Operations performed atworkshop

The hollow square section GI tubes were cut to desired length by sawing operation. The cut tubes were welded to build the required frame work. Holes were drilled on the tubes at the required places to facilitate clamping of different parts. A thin GI sheet was fitted on top of the frame so as to provide a platform for placing the electronic circuit. A thin projection is placed in front of chassis for attaching the ultrasonic sensor. Bearings are welded on to the under side of the chassis for fixing the wheels. A projection is placed to house the motor which drives the prototype. A small cylindrical part is welded onto the frame so as to hold the pneumatic cylinders in position where when the piston is displaced will hit the adjuster of the internal expanding shoe brake and thus cause braking action. Battery along with the microcontroller and other electronic components are fixed onto the earlier fixed GI sheet.



6. CALCULATIONS

Braking Distance = V / 2μg (meter)

Where

V= Velocity of the vehicle (m/s)

μ = Coefficient of friction of road = 0.8

g = Acceleration due to gravity = 9.81(m/s2)

Max RPM= 120

r= 5 cm

Max velocity =

$V = 2 * \pi * N * r/60$

$V = 2 * \pi * 120 * 5/60$

V = 62.83 cm/sec

Friction force=

f = μN

Retarding acceleration (a) is

ma = f = μN

$a = \mu * g$

$a = 0.30 * 981$ cm/sec2

a = 294.3cm/sec2

Time taken to stop

t =v/a

t =62.83/294.3

t = 0.21 sec

Distance travelled before stopping

$s = v2/2 * a$

$s = 62.832/2 * 294.3$

s = 6.70 cm

Now, for velocity 10 km/hr.

Braking Distance =
(10*1000/3600)/ (2*0.8*9.81)

= 18cm

For velocity 20 km/hr.

Braking Distance = (20*1000/3600)/ (2*0.8*9.81)

= 35cm

For velocity 30 km/hr.

Braking Distance = (30*1000/3600)/ (2*0.8*9.81)

= 53cm

For velocity 40 km/hr.

Braking Distance = (40*1000/3600)/ (2*0.8*9.81)

= 71c m

For velocity 50 km/hr.

Braking Distance = (50*1000/3600)/ (2*0.8*9.81)

= 88c m

7. ADVANTAGES:

1. Discrete distances to moving objects can be detected and measured.

2. Resistance to external disturbances such as vibration, infrared radiation, ambient noise, and EMI radiation.

3. Measures and detects distances to moving objects.

4. Impervious to target materials, surface and colour.

5. Solid-state units have virtually unlimited, maintenance free lifespan.

6. Detects small objects over long operating distance.

7. Ultrasonic sensors are not affected by dust, dirt or high moisture environments.

8. DISADVANTAGES:

1. Overheating of a wave emitter precludes the energy of ultrasonic waves emitted

there from being enhanced to a practical level.

2. Interference between the projected waves and the reflected waves takes place, and

development of standing waves provides adverse effects.

3. It is impossible to discern between reflected waves from the road surface and

reflected waves from other places or objects.

9.APPLICATIONS:

Some of the applications of this project are:

1. Used in high speed trains.

2. Used in military application such as spy robot.

3. Used in heavy trucks.

4. Used in heavy vehicles as well as light vehicle

10. RESULT

As a result of this automatic braking system, the function of each part is working well and the whole system is successfully accomplished. The safety distance is determined then the vehicle system is braked when the obstacle is detected. The ranging accuracy of ultrasonic sensor in this prototype is about 2cm to 1m and works effectively within the prescribed limit.

11. CONCLUSIONS

The prototype incorporating intelligent braking system is designed and fabricated. On testing , prototype applies brake automatically when an obstruction comes in front of the range of sensors and avoid an imminent collision. This is an innovative project on modern and advanced braking system.

The Intelligent braking system is an automatic braking system which can be incorporated in a wide range of automobiles. This braking system can be mainly used to avoid vehicle accident that occurs due to the absent mindedness of drivers or due to lack of sleep for long distance drivers and it also offers efficient vehicle speed control on inclined roads.

The conclusions are summarized as follows :

1. Designed and fabricated a prototype which uses proximity sensor and incorporates Intelligent braking system

2. This system can be installed in any series of automobile and can thus be instrumental in reducing collisionrates.

3. There is a large market ahead inIndia

12. FUTURE SCOPE

The future scope is to design and develop a control system based on an automotivebraking system is called “Automatic Braking System”. The Automatic Braking System with ultrasonic sensor would alert the driver when the distance between vehicle and obstacle is in within the sensing range zone then the brakes are applied. This is the new function in this prototype design that could be possibly used for all the vehicles. By making it safer, this system will provide better guarantee for vehicle’s safety and avoid losses. Therefore, the safety system of vehicles will be developed and may have more market demands.It can be further used for large type of heavy vehicles like buses, trucks, cranes, tractors, etc. We can surely get the information about the obstacle detection sense zone according to vehicle condition. It is verily useful to public sector and users. It is also avoids the accidents in large or metropolitan cities. So we feel it is a better idea for automatically braking of vehicle with moderate cost.

13. REFERENCES

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