International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 7, July - 2014

# Intelligent Driving Assistant System

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**Abstract--Most of the academic research on driving support systems focuses on automating the actual driving rather than assisting the driver by enhancing its awareness of the car's surroundings. None of such automated driving systems are currently available to the public. On the other hand, several types of practical driving-aid devices have been developed and made available on the market. Blind-spot detectors, lane change assistants, and back-up/parking sensors are a few examples. The current technology in driver support systems is diverse in terms of functionality, methodology and implementation. The common denominator of all those systems is obstacle detection by sensing: to this end they utilize various forms of sensors, such as laser light, ultrasonic, radar, infrared, and CCD cameras, which are very expensive techniques.**

**Reckless driving is another major moving traffic violation. It is usually a more serious offense than careless driving, improper driving, or driving without due care and attention and is often punishable by fines, imprisonment, and/or driver's license suspension or revocation. Reckless driving is often defined as a mental state in which the driver displays a wanton disregard for the rules of the road; the driver often misjudges common driving procedures, often causing accidents and other damages.**

***Index Terms-. Braking, Arduino &sensor etc***

## 1. INTRODUCTION

The vehicle has been used as a human transportation device more than 100 years. Since then, vehicles have been investigated in many ways and have become a technology intensive device. Few decades ago, electronic and sensor technologies were merged into vehicles as an intelligent driving assistance system. It is a system to help the driver in its driving process for safety and convenience with electronic sensors. Intelligent vehicle systems offer great potential to future mobility. An increase of intelligence in vehicle applications may improve safety and provide comfort. Several sources indicate the benefits of Intelligent Driver Assistance Systems and other Intelligent Transportation Systems to be significant. The sensor monitors driving circumstances and detects hazard events instead of human sense of vision, distance, and direction.
A large fraction of all automobile accidents is caused by the drivers lack or lapse of concentration while operating their vehicles. Some drivers tend to occupy themselves with distracting activities, such as tuning the radio, eating, talking to passengers, or making cellular phone calls. Other drivers find it difficult to maintain focus on driving, e.g., due to fatigue or health problems [2]. Elderly drivers may exhibit difficulties in personal mobility making it more difficult for them to reliably monitor the vehicle perimeter [3], due to harsh road. They may also develop other conditions having a negative (albeit not disqualifying) impact on their ability to focus on the road [4].
In this report, we discuss the design concept and operation of a driving assistant, whose responsibility is to alert the driver to the presence of potentially hazardous objects within the vehicle's perimeter. By combining tactile and visual feedback, the system effectively extends the driver's range of perception as far as road conditions are concerned. In addition to that, to put a check on reckless or rash driving, an accelerometer is used to detect rash driving and intimate concerned authorities regarding the same. The accelerometer is also used to provide data regarding road banking and accordingly a safe driving speed for the said angle of banking.
Thus helping the driver navigate through a busy road, it will also reduce the stress of driving and bring in positive correlation into the overall experience. The net outcome of this assistance will be a reduced probability of accident.
The goal of our work reported in this report was to establish the set of criteria for an effective implementation of a driving assistant, to define such a system, and to build its working model from inexpensive off-the-shelf components. The implementation was meant to yield further insights into the problem. For the sake of feasibility and easy demonstrability, the system has been installed on a ride-on toy car; however, its scalability to a real vehicle has not been lost from sight. One of our objectives was to make sure that the assistant could be in principle installed on any vehicle without permanent modifications to its exterior. For this reason, its sensor modules communicate over a link and are powered of batteries.

## 2. PROPOSED SYSTEM

As stated in the previous section, our main objective was to define and functionally verify a new inexpensive driving assistant addressing the need for broader area coverage and more effective stimulation for the driver. The design comprises of a network of sensors mounted around the exterior body of the vehicle. The system also employs an accelerometer to detect the rash driving and inform the concerned authorities regarding the same.

The proposed system contains various physically separate components: (i) four of them are the sensor modules, called nodes in the sequel, to be attached to the car's exterior (ii) an accelerometer sensor that indicates reckless driving and alerts to slow down the speed, (iii) one controller responsible for coordinating the operation of the nodes, collecting data from them and presenting alerts to the driver through a display or beep. The sensor modules cover the two front corners and the blind spots on both sides of the vehicle.

By the use of ultrasonic sensor, that calculates the distance of the obstacles or automobiles which are either stationary or in motion, information is given to the driver to be with precaution and take measures in order to be safe from colliding. The accelerometer sensor used in the system further informs the driver about the rash driving above a speed limit which may damage the car by various means.

## 3. LITERATURE SURVEY

In completing this project, some literature reviews have been done on several resources. The theory and description about the project have been considered as guidance in implementing this project work. In this chapter, an overview of some applications that are similar to the project and related project designs are presented.

Nearly half of all accidents are rear end collisions and over 90% of injuries sustained by occupants whose vehicles are struck in rear end collisions are in the neck region. More than 200,000 people in US suffer from such injuries annually [4].

A review of accident data in seventy-two 20 mph zones found that average mean speeds were reduced by 9 mph, from 25 mph to 16 mph in the zones [3]. On average, for every 1 mph speed reduction, there was a 6.2% accident reduction. All road accidents in the zones fell by 61%, and there was no evidence of accident migration onto surrounding roads. Traffic flows in the zones reduced by 27%. The effects were particularly significant for the most vulnerable road users:

- All pedestrian accidents down by 63%
- All cyclist accidents down by 29%
- Motorcyclist accidents down by 73%
- Child accidents down by 67%
- Child pedestrian accidents down by 70%
- Child cyclist accidents down by 48%.

The statistics of India are chilling, as at least 13% people die every hour in road accidents in the country as per the latest report of national crime records. In 2007-1, 14,000 people in India lost their life in mishaps, which is significantly higher than the 2006 road death figures in China (89,455).

The Nissan Brake Assist system with preview function utilizes information provided by Adaptive Cruise Control sensors to judge when emergency braking application may be required based on the distance to the followed vehicle and relative velocity. When an impending collision is detected a small braking force is applied to minimize the separation between the brake pad and rotor to reduce the break response time. The small braking force is activated when the target deceleration for stopping without colliding with vehicle ahead exceeds $5.88 m/s^2$[4].

The 2006 Mercedes-Benz S-Class is equipped with Brake Assist Plus (BAS PLUS) and PRE-SAFE brake. The available information suggests that both systems utilize a single 77GHz radar sensor capable of monitoring a typical three lane motorway environment in front of the vehicle with a narrow field of view angle of nine degrees up to certain distance. Two additional 24GHz radar sensors with an 80 degree field of view monitor the area immediately in front of the vehicle up to a distance of 30m. DISTRONIC PLUS is claimed to be an additional driver assistance system which also relies upon the radar sensors to provide adaptive cruise control at speeds between 0 and 200km/h, maintaining headway to the vehicle in front by automatically breaking the vehicle to standstill if required and then accelerating the vehicle as soon as the traffic situation allows [5].

Collision mitigation by braking is a joint development between Ford Motor Company's research and Advanced Engineering group and the Volvo safety centre previewed on the Mercury Meta one concept vehicle. The system uses the radar and the camera sensor to detect the vehicles on the road ahead, to determine whether a collision is imminent based on the position, speed or direction of other vehicle. Using estimates of collision threat and driver intent, the system provides warning to the driver and enhanced brake control when required by amplifying the driver's braking and automatically applying full braking when it determines with certainty that a collision with another vehicle is unavoidable. It is claimed that depending on the speed and road factors, the braking can automatically reduce vehicle speed by five mile/h or more before an impact [6].

## 4. OVERVIEW OF THE SYSTEM

The main function of the driving aid system is to detect the obstacles that potentially bring harm to the vehicle and driver. Mapping system can be displayed on a graphical user interface, hence to assist the driver to obtain the surrounding information of the vehicle. In addition to that, to put a check on reckless or rash driving, an accelerometer is used to detect rash driving and intimate concerned authorities regarding the same. The accelerometer is also used to provide data regarding road banking and accordingly a safe driving speed for the said angle of banking.

Thus helping the driver navigate through a busy road, it will also reduce the stress of driving and bring in positive correlation into the overall experience. The net outcome of this assistance will be a reduced probability of accident [5].

*4.1 Block diagram*

The concept of block has been categorized in mainly 2 sections, namely:

i) Ultrasonic sensors interfaced with Arduino Uno,
ii) Accelerometer interfaced with Arduino Uno

*4.1.1 Distance measuring unit*

Going on with the block diagram of first objective. Figure 4.1 which show the interfacing of ultrasonic sensors to the Arduino uno controller. This section consists of Arduino Uno which is a microcontroller board based on the ATmega8 and acts as a core controller. Each ultrasonic sensor is interfaced with the Arduino, so as to determine the distance of the obstacle at a certain distance from the automobile. Based on the nearest obstacle identified by the ultrasonic sensor the alert is displayed on the LCD with the distance of the obstacle. LM324 is used which acts as a buffer which designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible.

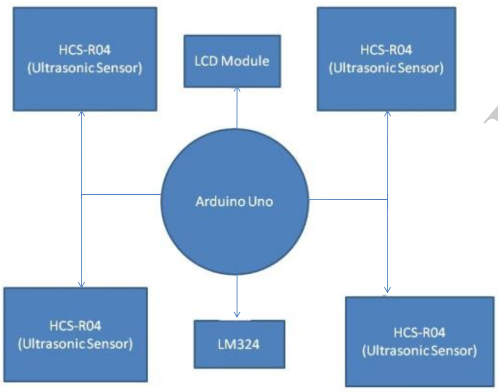


Figure 4.1 Block diagram

4.1.2 Accelerometer sensing unit

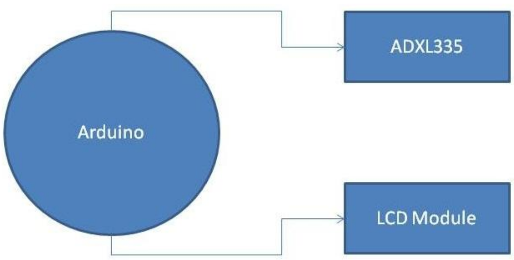


Figure 4.2 Block diagram of accelerometer interfaced with Arduino.

Figure 3.2 shows the accelerometer hall sensor which is controlled with an Arduino board. The accelerometer uses very little amperage, so it can be plugged into your Arduino and run directly off of the output from the Arduino's digital output pins. Accelerometer can be used to measure the static angle of tilt or inclination. A three axis accelerometer detects linear accelerations in three perpendicular directions. It consists of a ball inside a box with pressure sensitive walls. As the ball shake's around the box, the ball presses against different walls, which tells the direction of acceleration. If the accelerometer is not moving, the ball will still push against the walls simply due to gravity. By comparing the readings on the x, y and z axis, Arduino can work out the orientation of a stationary object.

Three-axis accelerometers like the one which has been used in this report measure's the linear acceleration of a vehicle on each axis—in other words, the surge(motion along the longitudinal axis), sway(motion along the transverse axis that is sideways motion), or heave(motion along vertical axis) of a vehicle.

They don't give the roll (rotational about a longitudinal axis), pitch (rotational about a transverse axis), or yaw (rotation about a vertical axis). However, Arduino can calculate the roll and pitch when you know the acceleration along each axis. That calculation takes some tricky trigonometry.



## 5. CIRCUIT DIAGRAM AND ALGORITHM

Here the detailed study about the flow of algorithm of the system will be discussed and also the function of complete system mentioning the importance of each units.

*5.1 Ultrasonic sensor module*

Ultrasonic sensors (also known as transceivers when they both send and receive, but more generally called transducers) work on a principle similar to Radar or Sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object[6].

This technology can be used for measuring wind speed and direction (Anemometer), tank or channel level, and speed through air or water. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water. To measure tank or channel level, the sensor measures the distance to the surface of the fluid. Further applications include: humidifiers, sonar, medical ultrasonography, burglar alarms and non-destructive testing.
Systems typically use a transducer which generates sound waves in the ultrasonic range, above 18,000 Hertz, by

turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed.

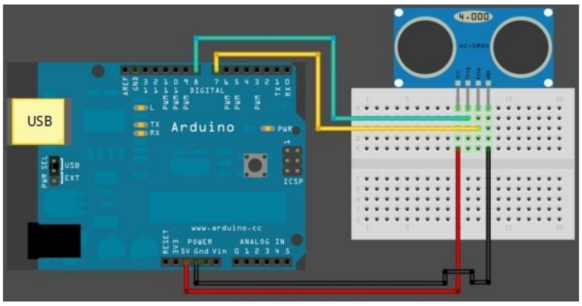


Figure 5.1 Circuit Diagram of Ultrasonic sensors interfacing with Arduino [11]

*5.1.1 Working principle*

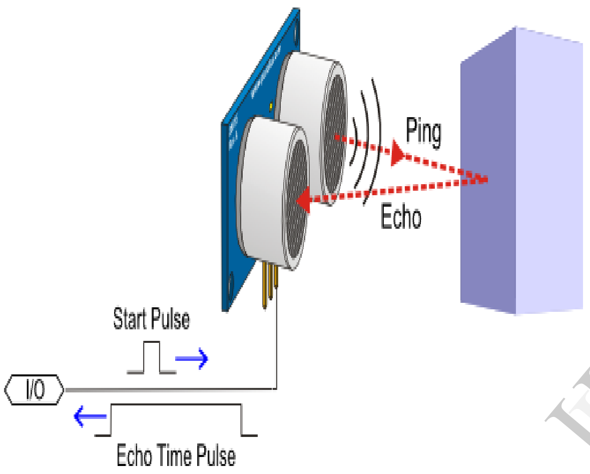


Figure 5.2 Basic Working Principle [5]

The distance sensor works by sending out a pulse of ultrasonic sound and measuring the amount of time it takes for the sound to come back, known as the 'time of flight' method as shown in the Figure 4.3. This is the same method bats use to find things by sound [6].

The sound goes out in a cone pattern, so the best detection is done. However, objects on the side of the cone can still be detected. The cone pattern is shown in Figure 5.3.

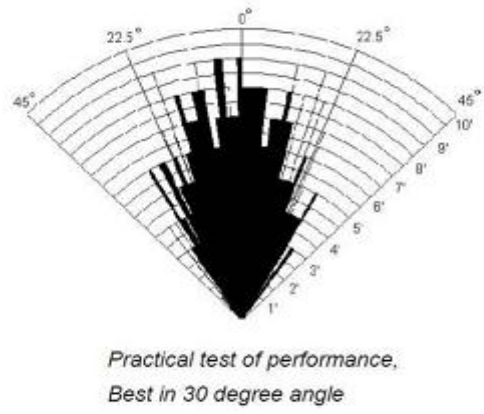


Figure 5.3 Cone patterns [5]

Since it works with sound waves, it works best on objects that easily reflect sound. Flat, smooth services (like a wall) reflect work best. Fuzzy, soft, irregular surfaces (like a dog) reflect the worst.

*5.1.2 Operation*



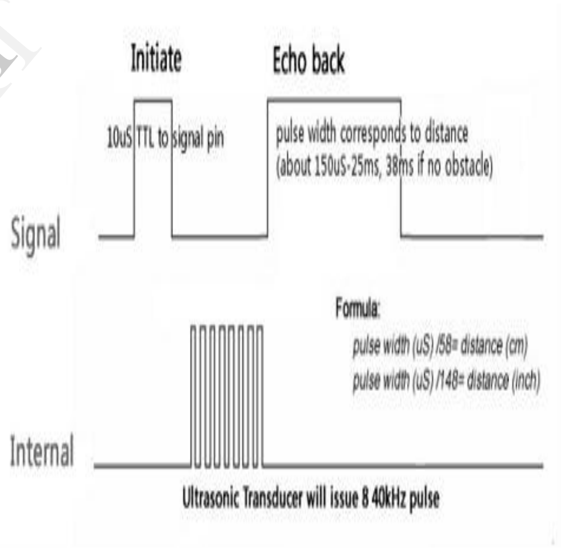


Figure 5.4 Operation of Sensor

A 10uS high pulse on the Trigger pin initiates an 8 cycle burst of 40 kHz ultrasonic pulses as shown in the Figure 4.5. The pulses return to the module, and it emits on the Echo pin a high pulse between 150uS and 25ms. The distance can be calculated from the formulas. They are derived from the relation i.e. Test distance = (high level time * velocity of sound (340M/S) / 2.

*5.2 Accelerometer*

An accelerometer measures proper acceleration, which is the acceleration it experiences relative to freefall and is the acceleration felt by people and objects. Put another way, at any point in space time the equivalence principle guarantees the existence of a local inertial frame, and an accelerometer measures the acceleration relative to that frame. Such accelerations are popularly measured in terms of G-force [7].

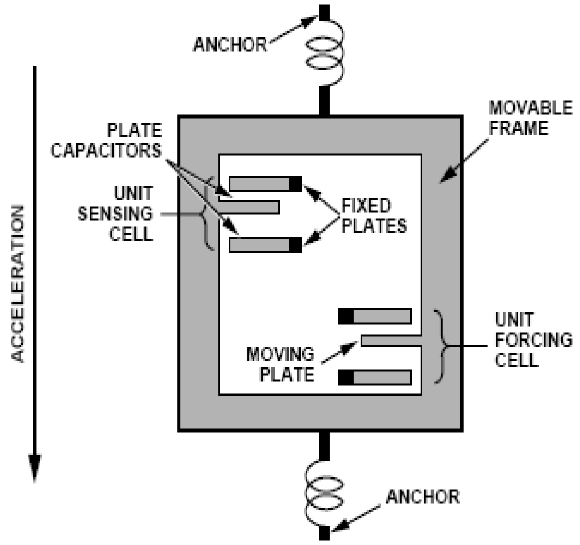


Figure 5.5 Accelerometer principle[9]

An accelerometer at rest relative to the Earth's surface will indicate approximately 1 g upwards, because any point on the Earth's surface is accelerating upwards relative to the local inertial frame (the frame of a freely falling object near the surface). To obtain the acceleration due to motion with respect to the Earth, this "gravity offset" must be subtracted and corrections made for effects caused by the Earth's rotation relative to the inertial frame.

The reason for the appearance of a gravitational offset is Einstein's equivalence principle, which states that the effects of gravity on an object are indistinguishable from acceleration. When held fixed in a gravitational field by, for example, applying a ground reaction force or an equivalent upward thrust, the reference frame for an accelerometer (its own casing) accelerates upwards with respect to a free-falling reference frame. The effects of this acceleration are indistinguishable from any other acceleration experienced by the instrument, so that an accelerometer cannot detect the difference between sitting in a rocket on the launch pad, and being in the same rocket in deep space while it uses its engines to accelerate at 1 g. For similar reasons, an accelerometer will read zero during any type of free fall. This includes use in a coasting spaceship in deep space far from any mass, a spaceship orbiting the Earth, an airplane in a parabolic "zero-g" arc, or any free-fall in vacuum. Another example is free-fall at a sufficiently high altitude that atmospheric effects can be neglected [8].

However this does not include a (non-free) fall in which air resistance produces drag forces that reduce the acceleration, until constant terminal velocity is reached. At terminal velocity the accelerometer will indicate 1 g acceleration upwards. For the same reason a skydiver, upon reaching terminal velocity, does not feel as though he or she were in "free-fall", but rather experiences a feeling similar to being supported (at 1 g) on a "bed" of up rushing air.

Acceleration is quantified in the SI unit meters per second per second (m/s2), in the cgs unit gal (Gal), or popularly in terms of g-force (g).

For the practical purpose of finding the acceleration of objects with respect to the Earth, such as for use in an inertial navigation system, knowledge of local gravity is required. This can be obtained either by calibrating the device at rest, or from a known model of gravity at the approximate current position.

## 6. RESULTS & CONCLUSION

Demonstration steps

1. Power supply of 12V is given from the battery to trigger the devices.
2. Ultrasonic sensor transmits a trigger pulse which gets the obstacle information which has been fed to Arduino for calculating the distance.
3.Further by the inbuilt code of Arduino for the ultrasonic sensor, the Arduino receives the signal and converts it to the digital value of the distance based on the pulse received and is displayed on the LCD display.
4.An accelerometer sensor continuously senses the axis based on the motion of vehicle according to the limits specified in the program for alertness.
5.In case, front sensor has the obstacle closest to it , program generates a alert by applying a buzzer sound.

*6.1 Experimental Results*

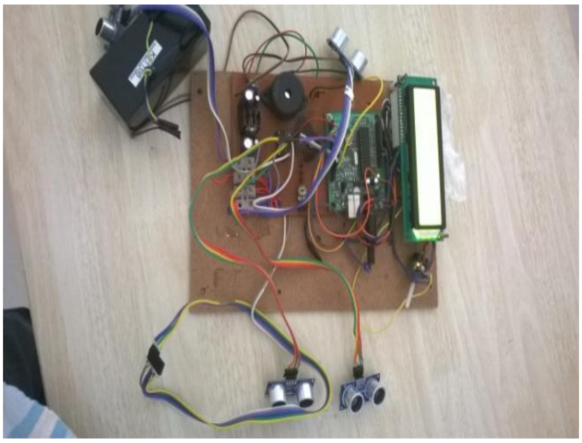

Figure 6.1 Range detecting module using ultrasonic sensors


Figure 6.2 Display when automobile is in driving state with no obstacle


Figure 6.3 Display when the right sensor detects obstacles


Figure 6.4 Display when vehicle is moving in stable state


Figure 6.5 Display when vehicle is negotiating the steep rise


Figure 6.6 Display when vehicle is driving through the slope


Figure 6.7 Display when vehicle is negotiating a curve


Figure 6.8 Display when vehicle is negotiating a curve

*6.2 Conclusion*

The project work to prevent certain percentage of accidents is successfully demonstrated.

(i) The driver is alerted about the possible collision that would take place.

(ii) The driver is alerted about the banking of the road and reckless driving.

Limitation of the project work proposed in this report is the sensor capacity in terms of range (distance) that it covers. In this work it is reported up to 4 meters which is insufficient for high speed vehicles. For high speed vehicles high range sensors are required. But to demonstrate the work using high range sensors was not possible due to the high cost of the high range sensors.

*6.3 Future scope*

(i) Implementing with high range sensors in the real time.

(ii) Collaborating with an automobile manufacturing company and getting equipped the vehicle with the proposed security unit in low cost vehicles.



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