Smart Electronic Driver Assistance Aid

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Abstract: In recent times, number of urban vehicles have been greatly increased which has led to various problems like road accidents and vehicle security. The objective of this paper is to develop an integrated system which will address road related problems. The developed integrated system embedded inside a car provides assistance to car drivers. The system is integrated with the owner's smart phone which enables vehicle tracking and locking functionalities. The system will reduce the probability of accidents as the driver is alerted well in advance for him/her to react and control the vehicle. Thus, this system will help to a large extent in increasing road safety and reduce accidents.

Keywords: Arduino; alcohol detection; blind spot detection; accident intimation; anti theft.

Introduction

The modern road transport system is an important lifeline which casts a direct impact on the everyday lives of humans. It has allowed man to travel long distances in a relatively short period of time and has undergone developments from time to time to enhance its capabilities. However, a significant disadvantage of road transport systems is the road accidents. Statistical surveys reveal that every five minutes, a person dies in a crash on Indian roads. Motor vehicle accidents are the most common cause of death in India, far more than cancer or heart attacks.

Drunk driving is one of the leading causes of fatal traffic accident. According to the report of the WHO, every 33 minutes there is one person who dies in the traffic accident caused by drunk driving.

A blind spot in a vehicle is an area around the vehicle that cannot be directly observed by the driver while at the controls. Blind spots may occur in front of the driver when the windshield pillar, side-view mirror and interior rear-view mirror block a driver's view of the road. The blind spot region is shown in Fig. 1.

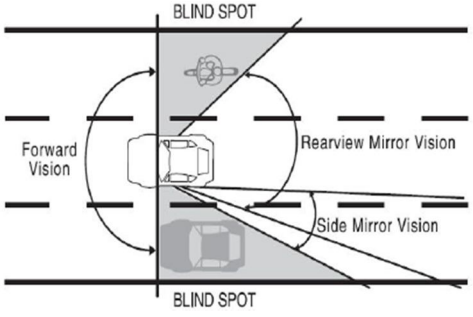

Figure.1 Blind spot region

Traffic accidents are one of the leading causes of deaths. An important indicator of survival of a person, after an accident, is the time between the accident and when emergency medical personnel are dispatched to the accident location. By eliminating the time between when an accident occurs and when the first emergency responders are dispatched to the scene can decrease mortality rate and save lives. As the number of urban vehicles increase rapidly with the development of the economy, people are getting more concerned about vehicle theft prevention. Car alarm devices are very popular these days.

This paper aims to provide add on features to the existing safety features in the vehicle. The controller present in the car can be used for interfacing the four different modules. Thus makes hardware architecture efficient.

The remainder of the paper is organized as follows. In Section 2, we review the related literature. The four different modules along with the design of integrated system for driver assistance are presented in Section 3. A preliminary set of results of a prototype of this implementation is presented in Section 4. The paper is concluded in Section 5.

Related Work

The serious cause for accidents is drunk driving in modern society. MCU (Master Control Unit) electronic circuit board is used in the system [4]. The alcohol gas sensor MQ3is used to detect the alcohol concentration; through ADC the detection signal is converted to digital signal, which is handled directly by MCU. According to the digital signal, the car is controlled automatically, can't be driven after driver drinking, thus avoid the occurrence of drunk driving. The concept has been derived for alcohol sensing, displaying concentration levels and alerting concerned authorities via a GSM module placed in the car.

The existing system for blind spot detection device for protection against automobiles collisions is not much efficient [1]. Technology used for this purpose works by detecting the other automobiles, obstacles. Upon detecting, the device triggers a timer that delays the activation of alarm circuitry for a brief period of time. From this paper, the concept was derived using ultrasonic sensors to measure distance of incoming vehicles and those which are close; a buzzer is used to warn the driver. Also a vision based assistance system to monitor the vehicle in the blind-spot area was proposed [2]. Image features which are directly obtained from vehicle images are used to detect vehicles possibility in the area. All features are built from training images; adaboost algorithm is used to choose the best features with better geometric information for detection [14]. The concept was successfully implemented to detect approaching vehicles in blind spot area using edge detection.

A system using the sensor inbuilt with the smart phones and also the on-board sensors fitted with the vehicle to detect the accident occurrence [8]. Once the accident has been detected, the effective path, taking into account both the distance and the traffic, to reach the accident spot is intimated to the relatives and to the nearby hospital. Based on the GPS-based FCD technique, the effective path to reach the accident spot is determined. The proposed approach aims at detecting the accident occurrence and providing timely notification and timely help to reduce the impacts of accidents. The concept was explained using impact sensors within the vehicle which detects when an accident occurs and the location can be tracked with a smart phone.

A system for tracking lost vehicles using GSM technology which would be the cheapest source of vehicle tracking anti-theft system has been proposed [3]. The system can be switched ON by an SMS from the owner, which in turn instructs the microcontroller to turn OFF the vehicle, receive information about the vehicle's current location or more. The microcontroller which receives the delivery messages through the GSM module determines the exact location of the vehicle in a given area. The concept has been derived for tracking lost vehicles using GSM technology and also disabling the vehicles. The concept for tracking lost vehicles using GSM technology and also disabling the vehicles also used.

From the above survey, it is clearly evident that there is a need for a system to address the concern of blind spots in vehicle. Also there is need to address the other problems related to driver alcohol levels. In the above mentioned papers there is no clear solution to increase the safety of the driver and the road transport. The common problems like blind spots and theft have been defined but there is no integrated solution provided.

Design and Implementation of all Four Modules in a Single Integrated System

Alcohol detection

It is important for public safety that drunken drivers are taken off the roads. Alcohol intoxication is legally defined by the BAC (Blood Alcohol Concentration) level. The Indian police have used breath analyzers from the past 10 years but not everyone is being subjected to these tests. So there has to be some form of pre-testing embedded within the car to avoid drunken driving. A sensor is used and interfaced with a microcontroller to detect the alcohol content. The concentration of the alcohol in the alveolar air is related to the concentration of the alcohol in the blood. As the alcohol in the alveolar air is exhaled, it can be detected by the MQ3 gas sensor which is shown in Fig. 2.

Figure2. MQ3 gas sensor

The basic algorithm for the alcohol sensor is shown via a flowchart in Fig. 3. The sensor along with its peripheral analog circuitry continuously monitors the sensor output. If the value of the sensor increases above the legal limit of alcohol then immediately the message is displayed on LCD and the concerned authorities are alerted via SMS using the GSM and if the

legal limit is not crossed the system continues monitoring the sensor value [5]. The SMS sent also contains the GPS co-ordinates of the location to the authorities. This feature is implemented via interfacing a GPS module to the Arduino controller.

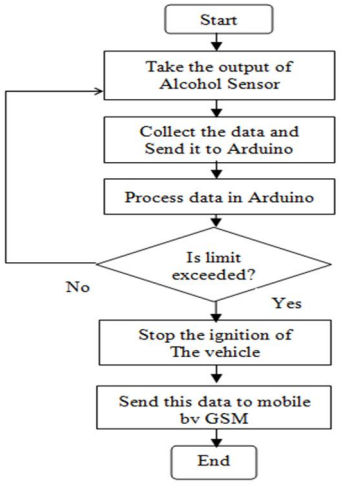

Figure3. Flowchart of anti-drunk system

Blind Spot Detection

Detecting the vehicles in the blind spot is another interesting area of research related to the road traffic accident prevention. Vehicles are installed with the rear view mirrors to enable driver to see the objects behind them [10]. As one is driving an automobile, blind spots are the areas of the road that cannot be seen while looking forward or through either the rear-view or side mirrors. The blind spot areas as shown below have become one of the main causes of accidents primarily on highways. IR sensor is used to detect the vehicle approaching and gives a warning to the driver. IR Sensors work by using a specific light sensor to detect a select light wavelength in the Infra-Red (IR) spectrum. By using an LED which produces light at the same wavelength as what the sensor is looking for, you can look at the intensity of the received light. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor as shown in the Fig. 4. The algorithm to find the obstacle or the nearby car approaching in the blind spot region is shown in the flowchart Fig. 5.

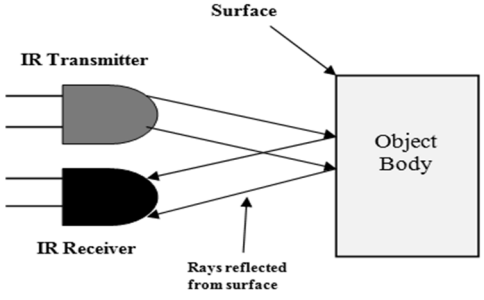

Figure4. IR sensor principle

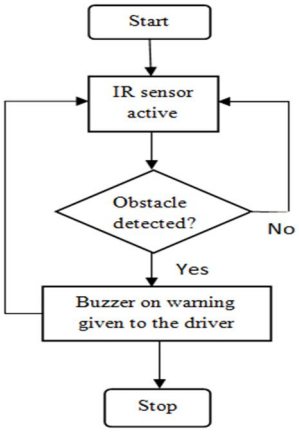

Figure5. Flowchart of blind spot detection

Intimation of Accidents

When an accident occurs, it is important to notify the nearby hospitals, so that they can reach the accident spot as soon as possible. The timely help to the accident victim could not be provided because of the heavy traffic prevalent in the area. So a novel approach has been designed to identify the accident spot and provide timely help using impact sensor which is shown in Fig. 6. When there is a pressure applied on the impact sensor, it sends a message to related person using GPS and GSM [11]. The algorithm for the accident detection is shown through a flowchart in Fig. 7.

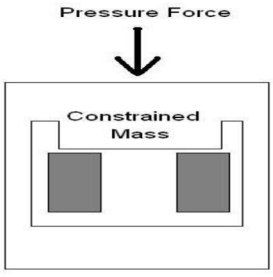

Figure6. Principle of impact sensor

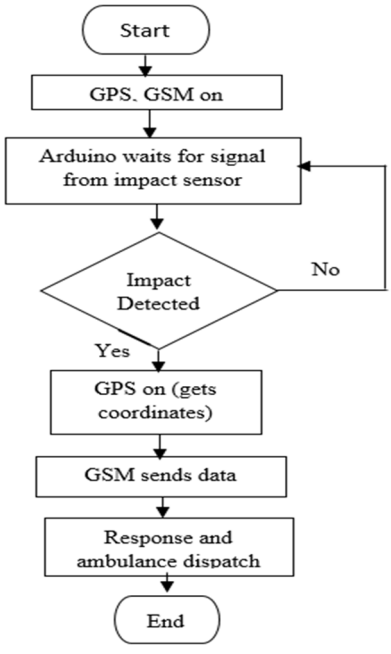

Figure7. Flowchart of accident detection

Anti-theft System

Anti-theft products are technologically classified into three categories: mechanical lock devices, car alarm system, and vehicle tracking/recovery systems, mainly aiming at preventing cars to be broken in and driven away [12]. The most commonly used mechanical lock device is steering wheel lock, which is relatively cheap but inconvenient to use and may be easily disarmed by skilled thieves. The wireless transmitter or the GPS device in the car will send wireless signals which can be picked up by the tracking device [6]. The wireless signals can be used to pinpoint the location and lead police to rapid recovery. However, these systems have high cost and often come with a monthly monitoring fee and the principle [7] is shown in Fig. 8**.** The algorithm to track the vehicle which is lost is shown in the Fig. 9.

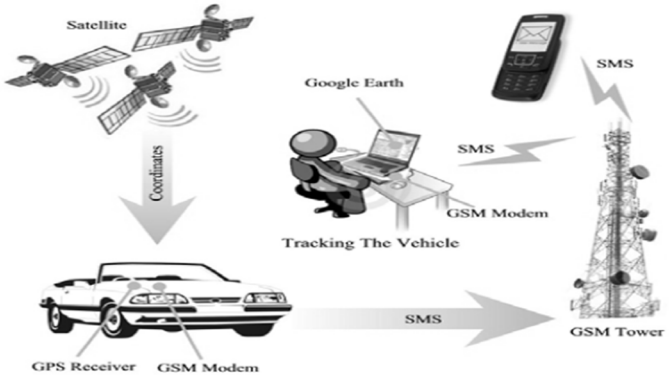

Figure8. Anti-theft principle

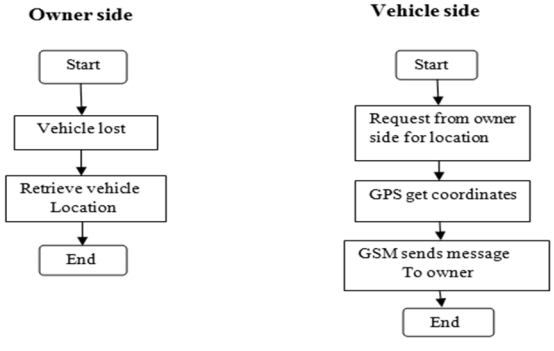

Figure9. Flowchart of anti-theft system

Complete System Implementation

As mentioned earlier, the objective is to develop an integrated system incorporating wide range of features; integration of all the components discussed in the previous sections was a major challenge. The final interfacing diagram is shown in Fig. 10. Interfacing alcohol sensor, ultrasonic and impact sensor was done using the general purpose input/output pins. The system starts working as soon as the driver starts the engine. First driver is tested whether he/she has consumed alcohol or not. If alcohol is detected, the engine stops. Otherwise it will be continuously checking for the other three modules i.e. blind spot, accident occurrence and antitheft. The flow of the system is shown in the flowchart Fig. 11.

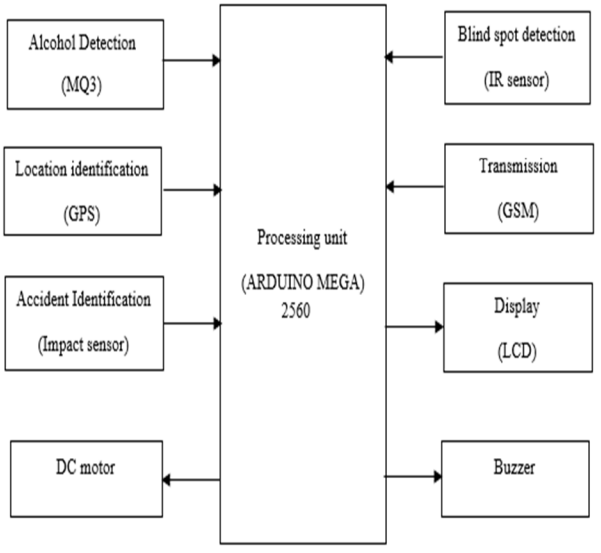

Figure10. Complete system implementation

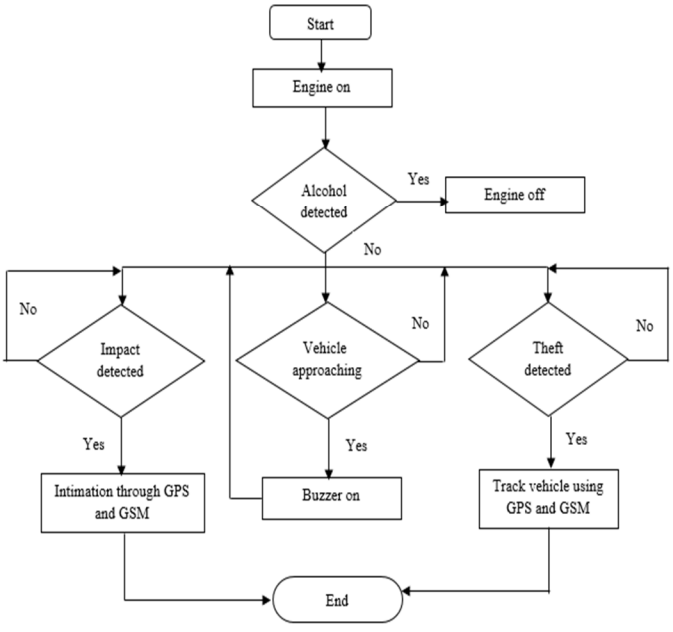

Figure11. Complete flow of the system

Results and Discussions

A complete integrated system was developed to fulfill all the objectives that were proposed. Once any system is developed the next important stage is testing for accuracy, efficiency, reliability and durability. As the system has different types of independent features, implementation was carried out for each feature first and then the finally integrated system was tested. To begin with, the results of the individual sensor outputs are deliberated and it is followed by the review of the results of the complete system integration. In the end significant inferences are obtained.

Alcohol Detection

This feature measures the alcohol level in the breath of a person and immediately notifies the concerned authorities if the alcohol level is more than the legal limit. The experimental testing was done with set-wet deodorant which contains 0.1% alcohol in 200 ml of deodorant. This amounts to 200ul. With the threshold set at the given concentration based on trial and error basis, the deodorant was sprayed on the sensor. As soon as alcohol is detected a status message “Alcohol Detected” is displayed on the LCD as shown in Fig. 12. The concerned authorities are notified via GSM along with the location of the driver as shown in Fig. 13. Thus, the system discourages drunken driving and prevents accidents.

Figure12. Alcohol Display message

Blind Spot Detection

To test this feature in the system, first the maximum range of the device was estimated. An IR sensor can measure the heat of an object as well as detects the motion. When the IR transmitter emits radiation, it reaches the object and some of the radiation reflects back to the IR receiver. Based on the intensity of the reception by the IR receiver, the output of the sensor is defined. As soon as the vehicle approaches the blind spot with distance being lesser than the threshold set, the driver is alerted via a buzzer as shown in Fig. 14.

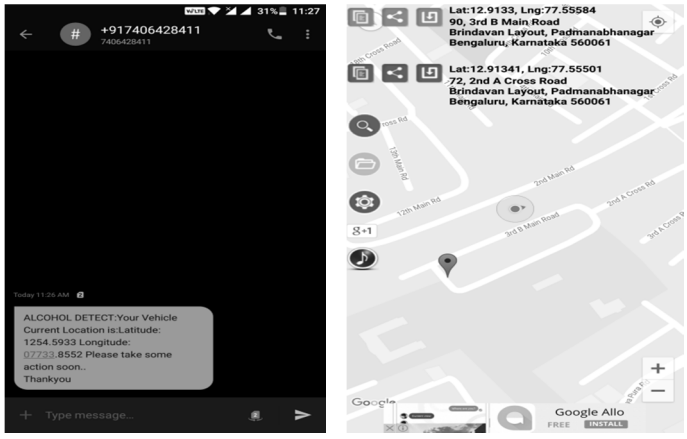

Figure13. Alcohol Detected Message to the Concerned Authorities

Figure14. Buzzer on Display message

Intimation of Accidents

A suitable threshold has to be set for the system as the system should ignore common vibrations from running engines and normal applications of brakes. When the measured impact level exceeds the threshold value, a message is sent to the related person/authority by using GSM and GPS modules and the location is as shown in Fig. 15. In this way emergency dispatch services can track and save people injured in traffic accidents with timely medical help.

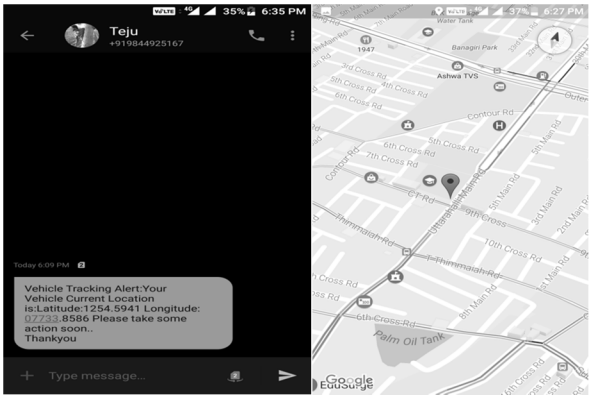

Figure15. Accident Detected Message and location to the related person

Anti-theft System

Car owner can track real time location of vehicles anytime by sending request to the controller to get location which sends the message of the location by GPS through GSM [9][13] as shown in Fig. 16 and also tracked location with the help of Google maps in the smart phone is also shown.

The complete vehicle embedded system is shown in Fig. 17. The Arduino mega 2560 microcontroller as shown forms the heart of the system. It receives data from various systems and takes suitable response. The main aim is to develop a product or a model instead of prototype. So we have created a car model and all the integrated components have been fitted into that car model in its appropriate positions as shown in the Fig. 18. This car moves forward with a 12v wireless battery. The

complete flow is as mentioned earlier. Initially if alcohol is detected the car model stops moving. Otherwise it continuously checks for the other three modules. Thus the car was developed successfully and all features have been tested and verified.

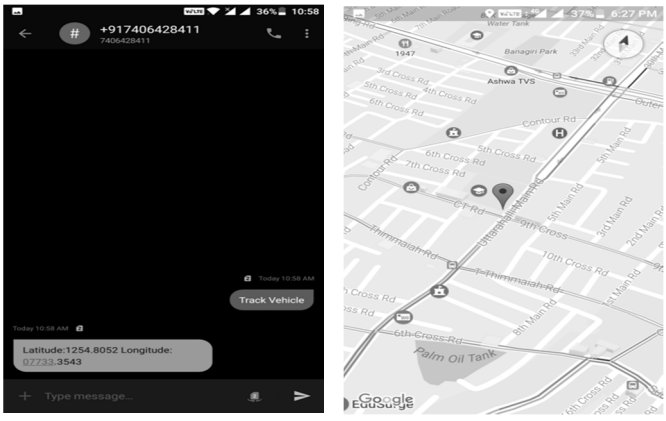

Figure16. Vehicle Location tracked

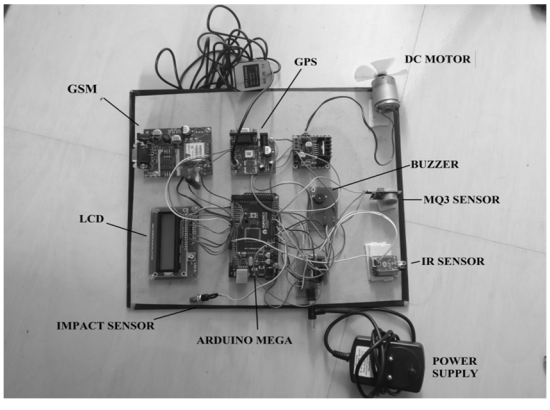

Figure17. Entire Integrated System Picture

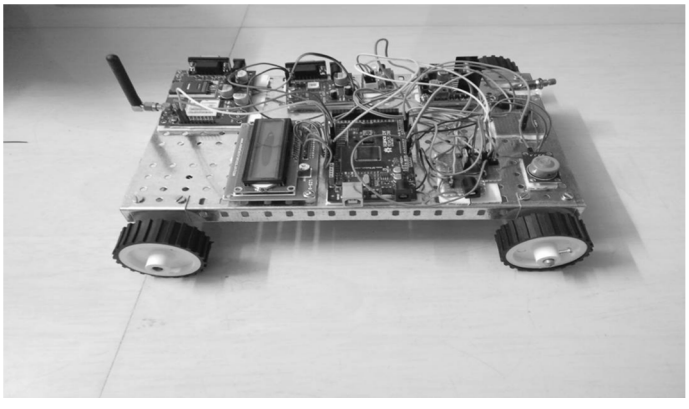

Figure18. Model of the car

Conclusion and Future Scope

The system detects the alcohol in breath and notifies concerned authorities successfully. The system for obstacle detection in Blind Spot region in vehicle is implemented and monitored accurately thus drastically reducing the probability of accidents. Intimation of accidents system uses impact sensor along with GSM and GPS to intimate the accidents to the nearest hospitals and thereby providing quick service to the accident site. Another system implemented is Anti-theft system which prevents the theft of a vehicle by integrating GSM and GPS module to indicate the exact location of the vehicle if it is stolen. Finally all the above systems are integrated to obtain a smart electronic driver assistance system. The product is cost effective and easily deployable. The future scope of this system would be to implement inter vehicular communication that would help reduce accidents and enhances driver safety. Blind spot detection can be more accurate with the help of ultrasonic sensors and image processing techniques. Anti-Theft System could be made more convenient and secure with the use of satellite modems. The concept of shortest path algorithm can be integrated into system in case of accident intimation. It can also be implemented in the heavy vehicles such as Lorries, trucks etc., so that the accidents can be minimized and save the lives of the people.

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