Intelligent Transport and Safety Assisting System

R. Kavitha, Niranjana C, M. Nirmala, S. Surya Prakash

Abstract: ***The novel concept Intelligent Transportation System (ITS) has been framed in this paper that provides accident detection system, seat belt monitoring, vehicle pollution monitoring and density based dynamic traffic control. Accident Detection system provides the information about the accident cases occurred in a place through GPS and GSM where the vibration of the vehicles after a certain limit is indicated using vibration sensor. In pollution monitoring system if the quality of emission of gas from the vehicle is not at standard rates it is detected by gas detection sensor and high emission is indicated by an alarm. When the seat belt is locked the motor gets triggered and starts the vehicle else the motor remains non- triggered. The traffic can be controlled dynamically using sensors and it sends data to the controller based on the density at each intersection of the junction. All these information assist the user to enhance the efficiency and accuracy.***

Index Terms: ITS, Density control, Safety assistant.

I. INTRODUCTION

Transportation infrastructure needs major revolution for the improved operational strategies to make city smarter. Sharing real time information about transportation issues between drivers and traffic management authorities will create awareness about the road facilities and provide information based on it. The vehicle security can be done by collecting data's of each vehicle status and its condition can be monitored in the central hub. The central hub may sometimes fail and thus the datas cannot be monitored. Instead of monitoring each vehicle from the hub a vibration sensor can be embedded into the vehicle to notify about the condition of speed in which the vehicle follows. Emission quality of vehicle must be analyzed, monitored and fine-tuned once it degrades to a safer limit.

A Two-level Traffic Light Control Strategy for Preventing Incident-Based Urban Traffic Congestion suggest that the proposed work designs a two level strategy at all signal junction intersection to prevent traffic congestion. [1].

The cooperation between traffic and warning signals is depicted with the petrinet models and the accuracy is verified. Among different strategies like fixed-timed, traffic responsive, and predictive control strategies used the traffic light control strategy at each junction plays a vital role in safeguarding the conflicts occurring due to flow of stream of vehicles and the crossing of pedestrians thus provides an efficient network operation[2].

The traffic control strategy algorithm being the efficient network some unexpected congestion may occur and thus an information system is employed where the information is sent to the drivers through links[3].

A Hierarchical Framework for Intelligent Traffic Management in Smart Cities prototyped a hierarchical framework with closed loop management system regulates the flow of traffic dynamically gaining efficiency and accuracy [4]. Wireless communication network is studied for smart system is discussed in [5].

The framework is based on multi-agent system that manages to control the potential traffic congestion and also minimize the travel time of the drivers. As the use of vehicular wireless communication increases it helps drivers to communicate with each other and with the central hub of the traffic management [6-7]. Application of Real Field Connected Vehicle Data for Aggressive Driving Identification on Horizontal Curves focuses on the real field connected vehicle data on horizontal curves. [8].

The developed model classifies the value of time to lane crossing (TLC) based on the set of speed of vehicles as feature using machine learning method [9]. Lightweight and compact braking system for fast deceleration uses a seat belt vibration system for awakening the drivers. Although wearing seat belt is a common safety system drivers do not prefer it due to discomfort and pain. The drowsiness of the drivers will be detected from their eye movement and facial expression [10].The survey adds that if the level of additional tension becomes higher than 130N for 3cycles at the interval of 100ms then the driver will be safe from all the unwanted deviation. A seatbelt retractor was built with no obstacles to the drivers and Minimize unnecessary discomfort [11].

II. INTELLIGENT TRANSPORT SYSTEM

This project has a dual aim of ensuring safety aspects for vehicle commuters and also to control the regulation of traffic at junctions.

- Protect the commuters by making them wear seat belt.
- To notify the user in case of exhaust exceeding certain limit.
- Sending messages to ambulance in case of an accidental emergency.
- Dynamically control the traffic based on the density at various junction of the roads.

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R. Kavitha, Electrical and Electronics Engineering, Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India
Niranjana C, Electrical and Electronics Engineering, Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India
M. Nirmala, Electrical and Electronics Engineering, Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India
S. Surya Prakash, Electrical and Electronics Engineering, Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India

The various sensors used in the system is shown in fig.1.The acceleration sensor detect the vibration which occurs due to accident and send message alert from GSM to ambulance.The pollutant gases are monitored by employing MQ2 sensor.A MQ2 sensor can be used to sense the leakage of gas and also can be used to detect the limit value of the emission gas. Wearing of seat belts is one of the major safety issue used in vehicles to avoid major injuries.

Unless or otherwise if the seat belt is not locked the sensor does not communicate with controller and the engine is off. Horn should have a control, a very high beep sound can cause the riders take wrong diversion leading to accidents. Horn control can be set to a limit such that exceeding that limit will be shown to the driver through a LED glow. The exponential increase in number of various vehicles leads to an increase in traffic congestion and thus it needs a dynamic control of traffic that can regulate the flow of traffic based on density of vehicles at each junction of roads. The array of sensors can detect the density and communicate with the controller and the required signal can be triggered for the proper flow of traffic.

In dynamic traffic density based control four pins of ultrasonic sensor and three signal LEDS are connected for each junction constituting 28 pins with the delay for each signal trigger. The ultrasonic sensor calculates the detection time with the angle of incidence and angle of reflection. It has four pins Vcc, Ground, Echo, Trigger. The trigger pin sends the wave to detect object and echo will be high once the object is detected and gives analog or digital output.

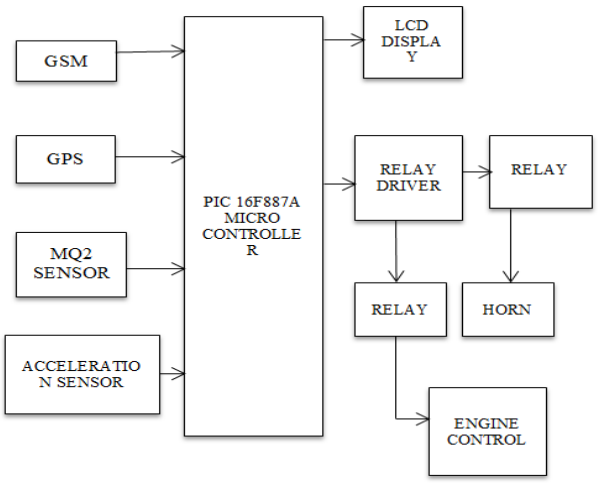

Fig.1 Safety assisting system

The Microcontroller used in this system is PIC microcontroller with 40 pins and 8-bit controller PIC16F887A has five Input/output ports where three ports B, C, D are used to interface the sensor with it. The arrangement of sensors is shown in fig 2

The port B and C is used for interfacing the accelerometer (ADXL 335). All the Vcc pins in the sensor is commonly connected to the Vcc of controller and the three axis X, Y, Z takes the port B and C and the circuit become complete. The predefined digital inputs are given to each axis and the tilt in the axis (or) the intensity of vibration is sensed by the accelerometer. Every result that is displayed in the LCD takes a delay 2000ms. The MQ2 sensor is interfaced with port E of the controller. The output pin always goes high (5V) when the concentration of gas is high and remains at low (0V). The seatbelt wire is taken from RC0 pin of controller and the grounding is done. If the wire is not in contact with RC0 pin the supply of motor connected in RB3 pin remains inactive and the vehicle does not start. If the wire is connected with RC0 pin then the supply flows to the RB3 pin of the controller and the motor is triggered to start position.The port A of the controller is used for GPS and GSM module.

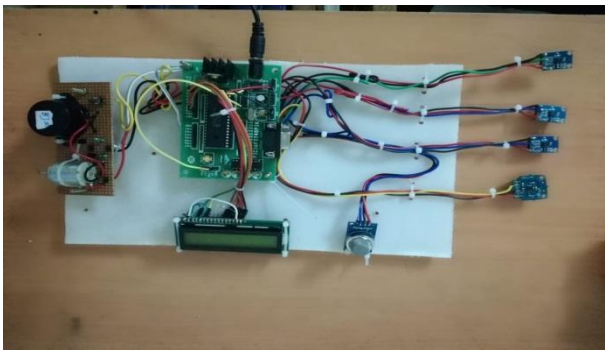

Fig. 2 Sensor interfacing kit

III. ACCIDENT AND POLLUTION DETECTION

The mechanical sensor ADXL-335 has three axes X, Y, Z. These three axes sense the vibration intensity with the raw minimum and maximum value as specified in the Table 1 and Table 2

Angle(◦)	0	10	20	30	40	50	60	70	80	90
Acceleration	510	485	455	433	408	390	374	363	357	355

Table 2 Angle of sensor from -90 to -10

Angle(◦)	-90	-80	-70	-60	-50	-40	-30	-20	-10
Acceleration	662	660	654	642	628	610	589	563	510

Table 1 Angle of sensor from 0 to 90

Based on the intense of vibration due to gravity the angle and acceleration changes and the sensor will figure out the tilted angle and speed. With the acceleration at three axes it gives an analog voltage output. The algorithm is detailed in the flowchart shown in fig.3.

There are four accelerometer sensorfixed at the four ends of the vehicle. The sensor utilizes the PORT C and PORT B of pic microcontroller. If the tilt of the accelerometer sensor is towards right, left and front with the raw value set at the range of unsigned integer 370-590.If the vibration is below the value of unsigned integer 370 or above the value of unsigned integer 590 then it is set to be detected as accident.

The message is displayed in LCD and through GPS the latitude and Longitude of the place is tracked and also with the GSM module the message is sent to the ambulance.

The simulation results for accident detection are shown in fig4.

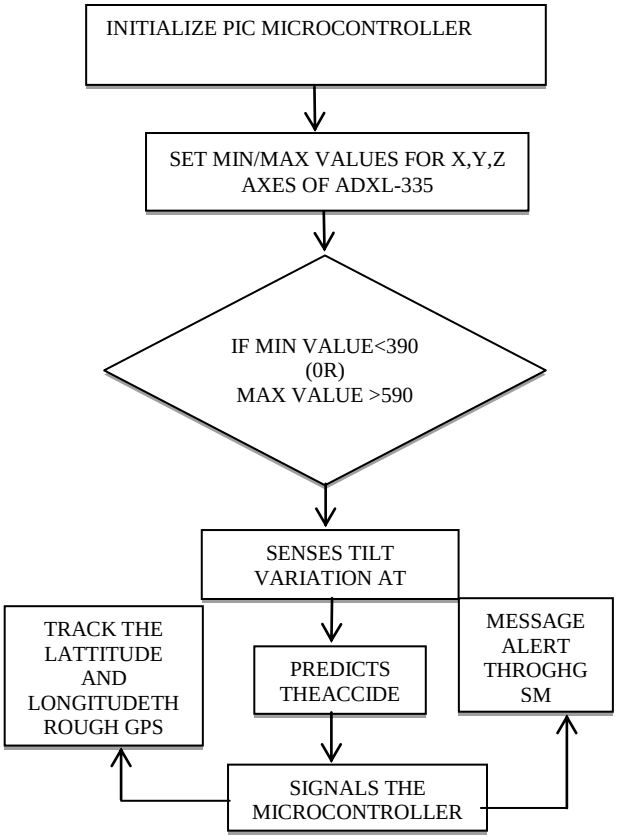

Fig.3. Flowchart of accelerometer section

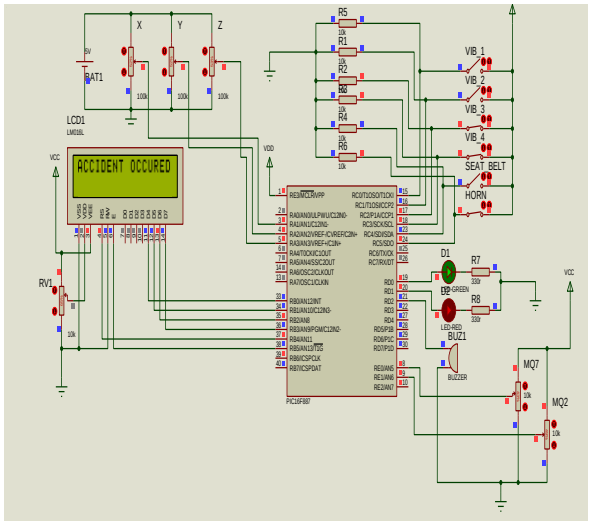

Fig.4 Detection of Accident

The hardware results after the detection of accident displays the latitude and longitude of the place in LCD and also alerts the ambulance through message through GPS and GSM as presented in fig. 5 and fig. 6. Most of the pollutants that the vehicle emits are Sulphur dioxide (SO_2), Carbon monoxide (CO), High pollution smoke, methane. These are the gases that are hazardous to the health when emitted outside the environment. The level of hazard measurement is shown in table 3.

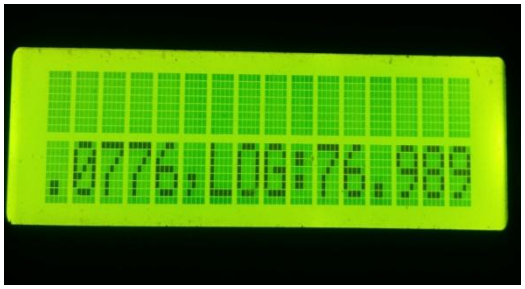

Fig. 5.Display of latitude and longitude of accident place.

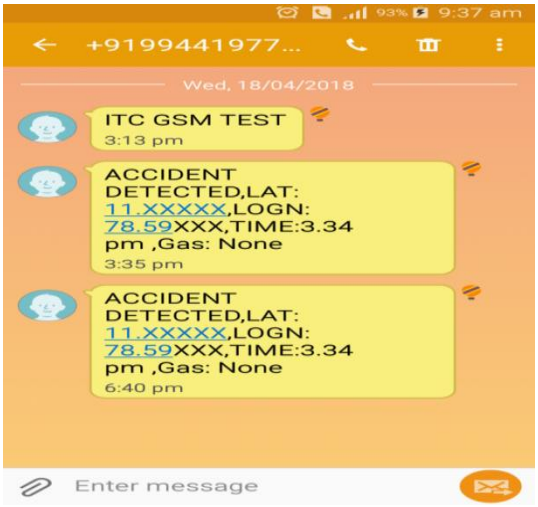

Fig. 6. Message alert for accident and gas emission through GPS and GSM

GAS	MINIMUM LEVEL(PPM)	MAXIMUM LEVEL(PPM)
SO_2	400	500
CO	30	50
CH_4	2.2	50000
SMOKE	50	100

Table 3 Hazardous level of gases

The MQ2 sensor is used to sense the leakage of gas and detects the leakage of gas which alarms the drivers about the emission levels. The sensor measures the level of gas with respect to the value of resistance produced when in normal air as base value and the resistance of sensor when placed near a gas. With these two resistances the sensor measures the concentration. The graph in fig 7 illustrates the concentration of each gas. If the pollutant smoke is induced near the MQ2 sensor the sensor senses the concentration in the rate of PPM of the gas with respect to the normal atmosphere. Once the gas emission is detected the output LED glows and with the delay of 200ms the buzzer alarms with the message to the user signalling the high gas emission.

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The port C of microcontroller is used for interfacing the seatbelt wire and if the RC0 pin is not locked then the motor never rotates by displaying the warning of seat belt in LCD as shown in fig 8.

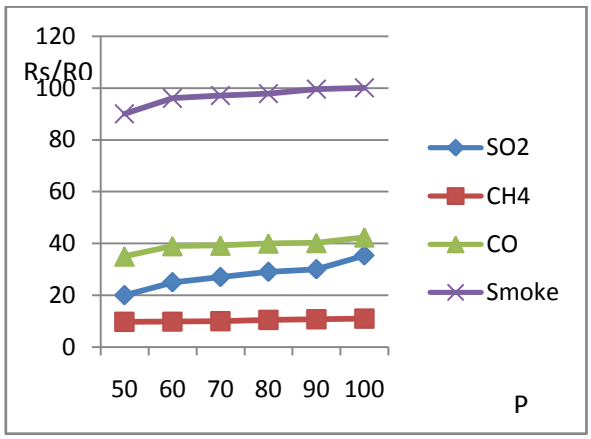

Fig. 7. Graph plot of concentration of gas

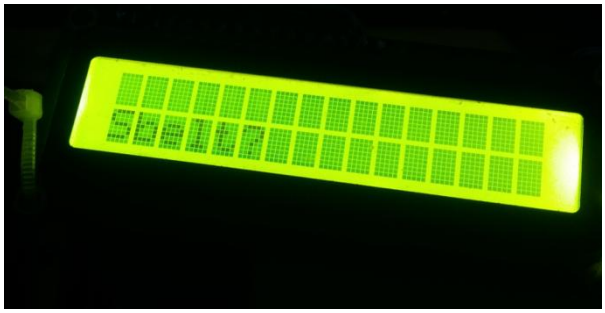

Fig. 8 Seat belt warning when unlocked

A coin vibration is used here to illustrate the start of motor by sensing the locked condition of seatbelt. At the same time when the 5V supply from microcontroller is given to the motor to run. Proper wiring of grounding is done.The RC0 pin of PORT C in microcontroller is taken as a seatbelt and given to ground(locked). The RB3 pin of PORT B in microcontroller is connected to the motor to rotate in a delay of 1000ms. All the sensors are mounted inside the car where the accelerometers are placed on the body of the car. The MQ2 sensor is placed at one back side of the car and the GPS and GSM module is mounted above the setup for the proper communication about the occurrence of accident. The seat belt near a seat and the motor is placed at the back bar of the car as shown in fig 9

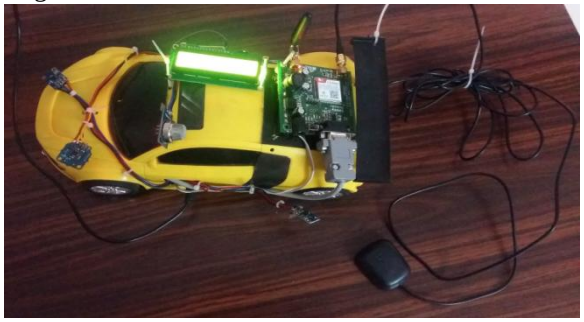

Fig.9 .Final set up safety assisting system

The result analysis of the complete safety assisting system is obtained and listed below in Table 4.

1.	**SEAT BELT**		**WORK OF MOTOR**
	LOCKED		ON
	UNLOCKED		OFF
2.	**ACCIDENT ETECTION (ADXL 335)**		**GSM AND GPS**
	Angle	Acceleration	The latitude and longitude of the accident place is sent to Ambulance
	0 10 30	510 485 455	
3.	**VEHICLE POLLUTION MONITORING(MQ2 SENSOR)**		**GSM AND GPS**
	Gas	PPM	The high emission alert is sent to RTO office
	Smoke	>100 (or) >250	

Table 4 Result analysis of safety assisting system

IV. DENSITY BASED DYNAMIC TRAFFIC MANAGEMENT SYSTEM

The traffic congestion occurs mainly because of inefficient guidence of signals at the junction. The ultrasonic sensors are used at the junction to measure the density range and signals the traffic LEDS based on the priority. The range of ultrasonic sensor ranges from around 2cm to 400cm. The sensor is mounted at 3.5m above the ground where the angle of reflection is 60^0 and angle of reflection is 10-15^0..Arduino Mega is used to connect all the ultrasonic sensor and the signal lights. The travel to the direction from north to south with East turn and travel to east to west with south turn is analysed with datas from the sensor. The time taken for angle of reflection and incidence measures the value of density. When the density goes above the particular value then the signal is triggered accordingly with free east or south turn with controlled north to south path. The path way is completely illustrated below in fig. 10.

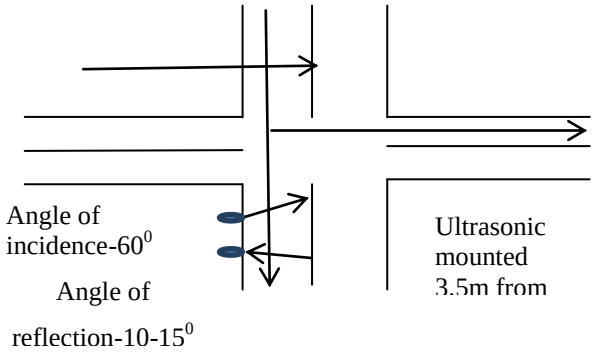

Fig. 10.Cases considered for dynamic control traffic lights

The four lanes of junction are set up and the ultrasonic sensor is kept at 3.5m from the ground at two junction and the traffic signals are placed at middle of the lanes. The vehicle at one junction is detected by the sensor and the density at that lane becomes high and signal is triggered for freeway flow at that particular junction. The lanes with the vehicle is shown in fig.11.

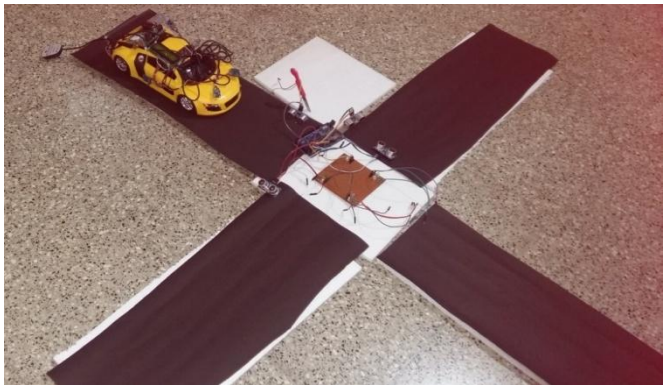

Fig. 11. Design of density based traffic system

When north and south direction is considered the density is measured after 2 feet from the junction. When the vehicle is detected the sensor senses the density and the signal at north south junction are turned green with 10 second delay. The results are presented in the Table 5.

	Analysis	Ultrasonic sensor 1(North South)	Ultrasonic sensor 2(East west)	Direction
				N TO S
				R Y G
North to South	Less than 2 feet	0	0	0 0 1
	At 3 feet before transition	1	0	0 1 0
	At 3 feet after transition	1	0	0 0 1
				E TO W
East to West	Less than 2 feet	0	1	0 0 1
	At 3 feet before transition	0	1	0 1 0
	At 3 feet after transition	0	1	0 0 0

Table . 5 Result analysis of dynamic traffic system

V. CONCLUSION

The intelligent transportation technique maximizes the infrastructure utility and provides prior information about the situation of roads and vehicle condition in advance to the user to avoid accidents. The accident detection system with accelerometer senses the vibration and transmits the signals to the GSM and GPS through the controller. The MQ2 sensor senses the concentration high level smoke emitted and provides the user about the level of gas through message. The safety of the drivers is also taken into concern by integrating seat belt with a motor so that only locking of seat belt will trigger the motor. All these features together provide the solution for safety assisting system.To control the flow of traffic the priority based system designed with ultrasonic sensor is integrated where the sensor senses the object at a range and determines the density at the junction providing good dynamic traffic flow at all the junctions.

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