COLLISION CONTROL AND COLLISION AVOIDANCE USING ULTRASONIC SENSOR

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Abstract— The paper proposes an intelligent collision avoidance system as a prototype, which avoids vehicle accidents and to provide a greatest security to the user in adverse or bad weather condition. Here, Ultrasonic sensor and IR sensors placed in the car, where IR sensor is used to detect the lane and avoids accident in significant manner. The vehicle state information is obtained using Ultrasonic sensor, which will continuously track for any obstacle from front side. If the obstacle is detected then microcontroller will continuously compare the distance given by Ultrasonic sensor. If the obstacle is closer to the car then the microcontroller will start applying the brake within the safe limit. The GSM provides warning message when the safety distance is reduced than safety limit. The overall system is controlled by ARM 7 and information is displayed on LCD.

Index Terms— Collision Avoidance System, Ultrasonic Sensor, IR Sensor, GSM, ARM 7.

I. INTRODUCTION

There are several advanced technology and innovations are available for vehicle safety. Even though there are advanced technological innovations for vehicle safety, the growth in number of accidents is continuously increasing. And these accidents are due to collision or intersectional accidents. Collision of vehicles occurs due to mistakes done by driver and intersectional accidents are caused due to bad weather conditions. Hence, to overcome these mistakes an intelligent collision avoidance system is proposed. So, the mistakes done by the driver are eliminated. Only sports cars and other luxury cars consist of antilock brake system, speed sensor, and other automatic systems. But these cars cannot be affordable to everyone. So, this system is developed which can be implemented in every car.

A collision avoidance system consists of several sensors that are placed within a car which provide warning to the driver if there are any dangers that lie ahead on the road. These sensors include how close the car is to other cars, how much its speed needs to be reduced when obstacles closer to the car, how close the car going off the road, And the system consist of audio warning to prompt the driver, initiates braking if the driver fails to respond to the warning. Since the system consists of sensors which send and receive signals from other cars, obstacles on the road. A good example of the system is how it works when a driver is about to change lanes, and there is an obstacle in his blind spot. The sensor will detect that obstacle and give information to driver before him start turning his car, and prevent him from getting into serious accident.

There is lot of techniques available for distance measurements and to avoid forward collision but the one technique which is introduced in our system is fast, effective, and cheap by using ultrasonic sensor. Ultrasonic sensor is used to measure the distance with respect to the preceding car. Hence, the rear end collision can be avoided by using ultrasonic sensor. In our proposed system, we use humidity sensor to calibrate the level of humidity in the surrounding environment. If the humidity level is less than fixed threshold then the sensor alerts the system by giving warning signals for bad weather conditions. This project effectively avoids accident in significant manner by applying the brake properly at right situation in

right direction.

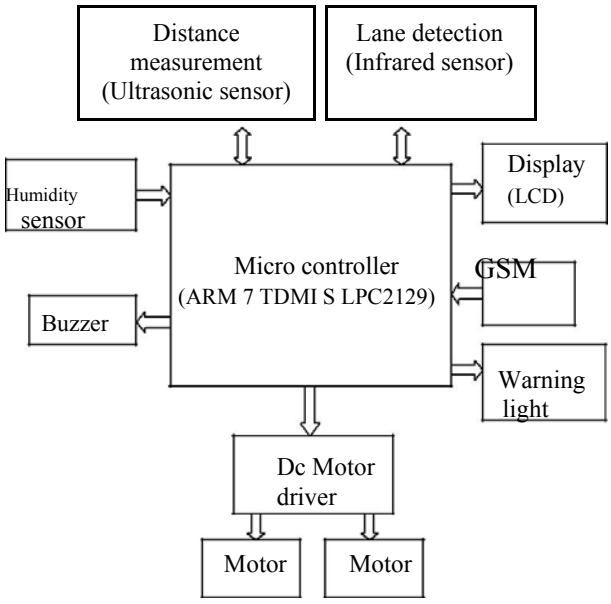
II. FUNCTIONAL DESCRIPTION

The functional block diagram of the system is shown in the figure 1. The system consists of different modules and there function is explained in the following.

The proposed system is designed by a prototype vehicle which can drive automatically without changing lanes and avoid front end collision or forward collision. The system is developed by a 32-bit microcontroller ARM 7 TDMI S LPC2129 which drives the car automatically. It is used in the system because the microcontroller having good speed of operation, inbuilt ADC, advanced CAN channels, PWM interrupt pins. There are two infrared sensors placed on both sides of the car, where lane detection is done by using infrared sensor. IR sensor consists of a transmitter, an infrared LED and a receiver, a photo diode, which is used in detecting the color variation in the road.

The ultrasonic sensor is used to measure the distance between the car and preceding car or obstacle. The level of humidity in the surrounding environment is calibrated by humidity sensor. LCD is used for displaying status of the system, such as distance, humidity, and message from the owner. The external GSM module placed in the car which controls the vehicle through mobile phone. Two separate DC motors are used, where motor driver L293D will drive these DC motors independently for running the vehicle.

Fig. 1. Functional block diagram



A. ARM 7TDMI S LPC2129

It is basically a general purpose 32 bit processor, and incorporated with the 32 bit controllers manufactured by Philips with the banner name LPC series controllers. ARM 7 was the first 32 bit controller.

ARM 7 TDMI S consists of 64 pin package with 46 GPIO port pins. 16KB of On-chip Static RAM to store Code or Data, and provided with 256KB of flash memory. It supports 1½ port concept and it has on chip crystal oscillator ranging from 1 to 30MHz. Supports ISP& IAP via boot loader. 2 CAN Controllers with Acceptance Filters. It consists of 10 Bit ADC with conversion time of 2.44micro sec. Two, 32 Bit Timers, PWM with 6 outputs and two UART's are inbuilt features of this microcontroller.

There are basically 2 ports in LPC2129, Port0 and Port1. Port0 has 32 pins reserved for it. And Port1 has 16 pins. So total it comes to 32+16 = 48 pins. If it were really 2 ports then the number of port pins should have been 32 + 32 = 64. Hence, ARM 7 supports 1½ port concept.

B. Ultrasonic sensor

The module used is HC-SR04 ranging from 2cm-4cm. It has the accuracy of 3mm. The sensor consists of ultrasonic transmitter, receiver and control circuit. It consists of 4 pins they are VCC of 5v, input trigger pulse, output echo pulse, and ground. The electric parameter of ultrasonic sensor is, its working voltage 5v DC, its operating frequency is 40kHz. It has triggered input signal of 10us TTL pulse.

Ultrasonic sensor works on the basic principle of piezoelectric effect. The block diagram shown in figure 2 depicts the working principle of sensor.

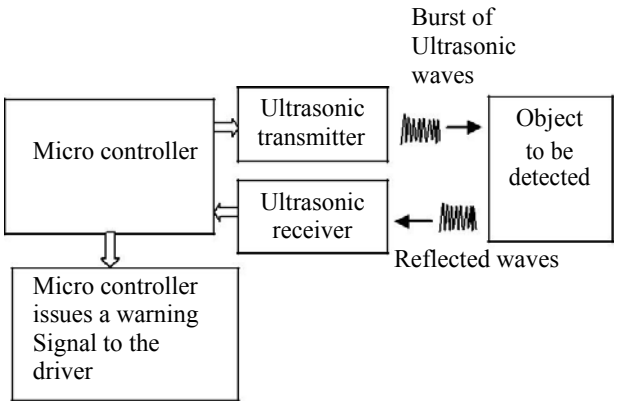


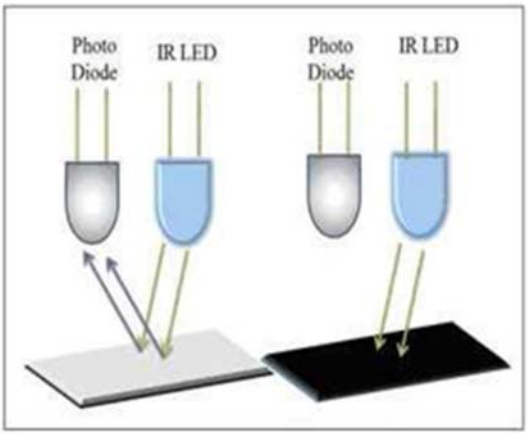
Fig. 2. Working principle of ultrasonic sensor

To trigger input a short 10us pulse is supplied, and then the module will send an 8 cycle sonic burst of ultrasound having the frequency of 40kHz. Once the obstacle is detected, the reflected waves (echo) are sensed by the receiver and analyzed by the microcontroller. If the distance is not in the safe limit, then the microcontroller issues a warning signal to the driver.

When the received echo is faded away, the next trigger pulse is sent and this time period is called cycle period. HC-SR04 cycle period must not be below 50ms.

C. Infrared sensor

Infrared sensor is an electronic device which is used for lane detection. It consists of one emitter (infrared LED) and one receiver (photo diode). They are placed in such a way that the light emitted by the LED is collected by the photo diode. If black surface is used, it absorbs the light emitted by LED and receiver cannot sense light. If the surface chosen is white, then the light emitted by IR LED gets reflected and it will be sensed by photo diode which is shown in below figure 3



The output of the sensor is given to the comparator inverting terminal as the input, and compares this signal with reference voltage set by potentiometer. So, when the emitter pair on the reflecting surface, the sensor is on. Hence, brightness of the object is measured by this type of sensor. This sensor is useful for lane line tracking.

D. Humidity sensor

The quantity of water vapor present in air is called humidity. It is measured in relative denoted by %RH. The sensor used is HSM-20G. Relative humidity converted to standard voltage output in HSM-20G.

The ratio of partial pressure of water vapor to the saturation vapor pressure of water is called relative humidity. It is calculated by

$$\varphi = \frac{e(w)}{e^*(w)} * 100\%$$

Where,

φ=relative humidity

e(w)=partial pressure of water vapor
e*(w)=saturation vapor pressure of water

In our proposed system, we use humidity sensor to calibrate the level of humidity in the surrounding environment. If the humidity level is less than fixed threshold then the sensor alerts the system by giving warning signals.

E. Global System for Mobile Communication (GSM)

The GSM module SIM 300, used in this system, is interfaced with the microcontroller ARM LPC2129. It operates at the frequency band 900MHz. The GSM module is used communicate with the microcontroller through UART. RXD (receive), TXD (transmit), GND (common ground) are the three basic signal of GSM. Serial port interface of GSM Modem consists of RTS and CTS signals which are connected with each other.

The transmit signal of serial port of microcontroller is connected with transmit signal (TXD) of the serial interface of GSM Modem while receive signal of microcontroller serial port is connected with receive signal (RXD) of serial interface of GSM Modem. To send commands from the microcontroller to the number stored a set of pre-registered commands called AT commands are used. These AT command are designed according to the ITU-T (International telecommunication union, telecommunication sector) V.25ter document.

IV. SOFTWARE IMPLEMENTATION

Keil µvision3 IDE is the software used to program microcontrollers. The microcontroller used in our system is ARM 7 LPC2129 IDE (Integrated development environment) provides to develop the code.

The ARM microcontroller is programmed by HLL (high level language) c. ARM supports ISP (In-system programming), and the programming interface called SPI (serial programming interface) where the code is transferred from PC to microcontroller. To dump the hex code from keil IDE into microcontroller the software used is flash magic through SPI interface.

RESULTS

The system designed as a prototype and has been tested using all the modules mentioned in the functional description. These modules are assembled on a single board shown in figure 4. The result for each input parameters of the prototype is given below

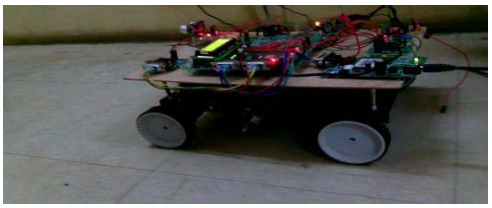


Fig. 4. Prototype car model

A. Ultrasonic sensor

The output of the ultrasonic sensor is shown in figure 5. If the distance is less than threshold value the automatic brake is applied by the microcontroller.

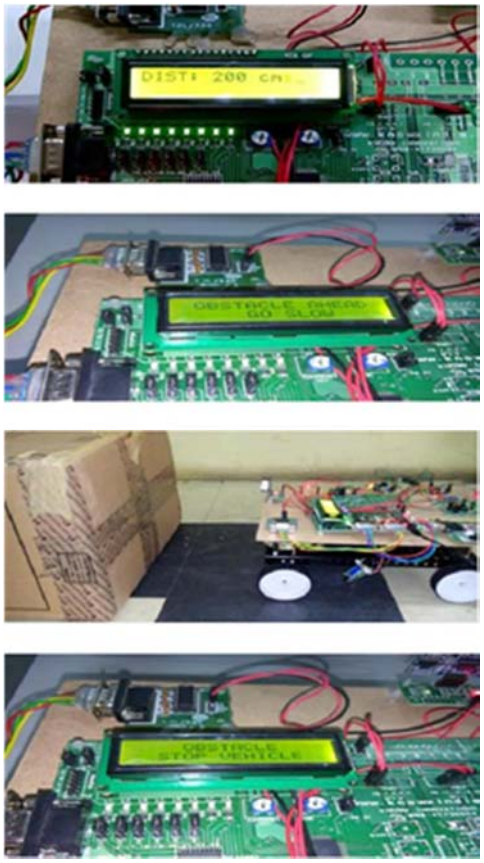


Fig. 5. Output of ultrasonic sensor is displayed on LCD

B. Infrared sensor

The output of IR sensor is explained in the flow chart shown below

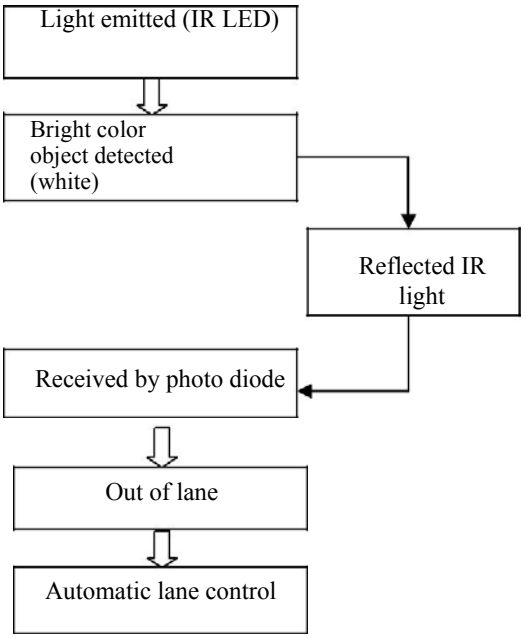


Fig. 6. Flow chart of IR sensor

Fig. 7. Output of IR sensor

C. Humidity sensor

The output of humidity sensor is explained in the flow chart shown in figure 7.

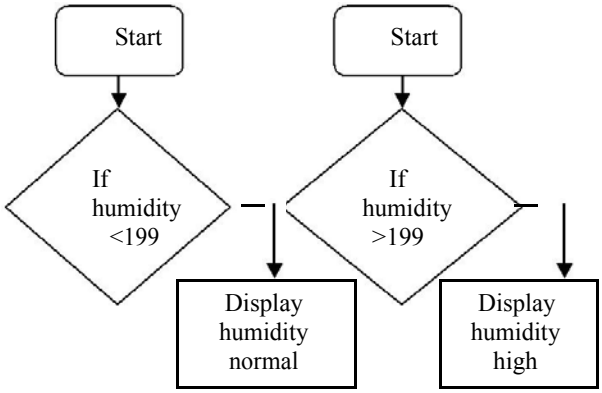


Fig. 8. Flow chart of humidity sensor

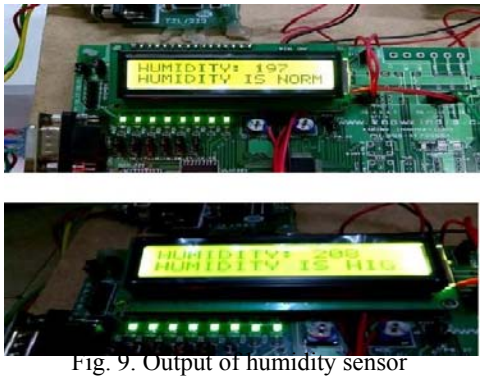


Fig. 9. Output of humidity sensor

IV. CONCLUSION

The proposed system is designed into a small car model as a prototype to control the distance between the car and the preceding car and also distance between the front obstacles and initiates automatic braking. System detects the lane line and automatic lane control is done to avoid accidents in a significant manner. Lane detection will ensure that car follows proper lane discipline for safety purpose.

ARM 7 microcontroller is used which eliminates the rounding problems and resulting in near perfect distance reading. The alert mechanism used in system will facilitate the vehicle driver at any unusual movement of the vehicle.so, if this system is used in fully automate cars with adaptive cruise control the overall safety will be further enhanced.

REFERENCES

[1] Triveni Shinde and B. V. Pawar, ―Car anti-collision and intercommunication system using communication protocol‖, International journal of engineering sciences and research technology ISSN:2319-7064,Volume-2, No-6, pp.187-191, June-2013

[2] S. Saravanan, T. Kavitha, ―Vehicle navigation and obstacle detection system using RFID and GSM‖, Journal of Theoretical and Applied Information Technology, Vol. 38, No-2, pp.206-209, 30th April 2012

[3] N . S. Vaidya and A . V .Nikalje, ―Arm based invention in car mobility and atomization‖, International journal of engineering and innovative technologyISSN:2277-3754,Volume-3,No-5, pp.238-244,november-2013

[4] Vivek agarwal, N. Venkata Murali, and C. Chandramouli, ―A Cost-Effective

Ultrasonic Sensor-Based Driver- Assistance System for Congested Traffic Conditions‖, IEEE Trans. Intell. Transp. Syst., vol.10,NO.3, pp. 486-498, Sep -2009

[5] Shival Dubey and Abdul Wahid Ansari, ―Design and development of vehicle anti-collision system using electromagnet and ultrasonic sensors‖, International Journal on Theoretical and Applied Research in Mechanical Engineering ISSN: 2319 – 3182, Volume-2, No-1, pp.80-83, Jan-2013