Automatic Braking System

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Abstract- *This paper presents an Advanced Automatic Braking system with sensor fusion concept. It uses the properties of both capacitive and infrared sensors for detecting the obstacles and also for calculating the distance between the vehicle and the obstacle. So the resulting system can achieve measurements with high accuracy and improved short distance measurement also. This distance measurement is used to control automatic braking system for safety applications. The brain of the embedded system part can be developed on 32bit microcontrollers with ARM processor (LPC2138). The programming of this controller is done using C language. The system also provides features such as Automatic Speed reducing and Automatic Horn disabling in a restricted area. This is done through RF signal communication.*

Keywords- : *Capacitive Sensing, Object Detection, Sensor Fusion, Ultrasonic and Automotive Sensors.*

1. INTRODUCTION

Driving is a compulsory activity for most people. People use their car to move from one place to other place. The number of vehicle is increasing day by day. Proportionally the numbers of accidents are also increasing. Nowadays, the numbers of accident is so high and uncertainly. Accident will occur every time and everywhere and cause worst damage, serious injury and dead. These accidents are mostly caused by the delay of the driver to hit the brake.The main target for this project is, cars can automatically brake due to obstacles when the sensor senses the obstacles. The braking circuit function is to brake the car.

Automatic Breaking System:

Automatically when the sensors detect any. Automatic Braking is a technology for automobiles to sense animminent collision with another vehicle, person or obstacle; or a danger such as a high speed approach to a stop sign and to respond with the braking system by either prechargingthe brakes or by applying the brakes to slow the vehicle without driver input. Efforts have been reported for sensing vehicle surroundings with different visible, non-visible (infrared) light and time-of-flight sensors. Although infrared sensors are well accepted technology for distance sensing applications. Sometimes these sensors reveal drawbacks in the immediate vicinity of a vehicle. According to, Infrared sensors exhibit a dead zone directly in front of the sensor plane. In this dead zone, accurate measurements cannot be taken with reasonable efforts (higher hard ware complexity etc.). In comparison to IR sensors, capacitive sensing technology offers the advantage of a volumetric measurement principle which can be used also for short distance sensing. This technique allows for both, detection and classification of objects. Combined with IR sensors, this can be exploited to design an improved distance measurement system, which provides the measurements with high accuracy [1]. The additional features included in this system are Automatic Speed reducing and Automatic Horn disabling in a restricted area. This is done through RF signal communication. In this, a RF transmitter is placed in an area, where the Speed is limited and the Horn is restricted. The RF transmitter placed in the traffic signal, transmits the value of limiting speed in km/hr, and a signal corresponding for disabling the Horn. The Vehicle decodes the transmitted signal from the transmitter, and then automatically reduces the speed into particular rate, and the Horn is disabled in that area. This featre is very useful in the safety applications. This decreases several problems in automotive fields.

2. SYSTEM ARCHITECTURE

The system architecture can be divided into two sections as hardware architecture and software architecture. In the following sections I give a brief idea about the both of the architectures.

Hardware Architecture

The brain of the embedded system part can be developed on 32bit microcontroller with ARM processor (LPC2138). The programming of this controller is done using C language. The hardware section again divided into two as transmitter and receiver section.Both sections are shown in

Transmitter Section

In this section Infrared Sensors and capacitive sensors are attached to the one of the ARM processor. Infrared and Capacitive sensors are used here for sensing the distance. This sensors continuously tracks the distance from the obstacles in its vicinity, and it is giving the information to the first LPC 2138 controller. The controller read ultrasonic sensor value from uart(rx) and also read capacitance sensor value from ADC channel[4]. Finally these information are processed in the controller and it communicate or giving information to the receiver section which contains the second LPC
2138 controller with the help of CAN protocol.The values are transmitted to the receiver section through Serial Peripheral interface.

Receiver Section

This section consist of DC motor, RF decoder and LCD attached to the second LPC 2138 controller. This controls the automatic braking system depending upon the distance measurement. Braking system works with
the help of a DC motor. The RF decoder connected to the controller decodes the transmitted signal from the RF transmitter and the controller reads RF decoder values from UART. Then automatically control the speed into particular rate depending upon the ultrasonic sensor,capacitive sensor and RF decoder values.Also the Horn is disabled in the restricted area. The LCD displays the information that can be viewed by the driver.
The LPC2138 micro controllers are based on a 32bit ARM7TDMI-S™ CPU with real-time emulation and embedded trace support, that combines the 64 kB,of embedded high speed Flash memory. Due to their tiny size and low power consumption, these micro controllers
are ideal for applications where miniaturization is a key requirement. With a wide range of serial communications interfaces and on-chip SRAM options of 32 kB, they are very well suited for our project development. Various 32-bit timers, single or dual 10bit 8 channel ADC(s), 10-bit DAC, PWM channels and 47 GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers particularly suitable for robotic applications.

Infrared ranging and detecting devices use highfrequency sound waves to detect the presence of an object and its range. The systems either measure the echo reflection of the sound from objects or detect the

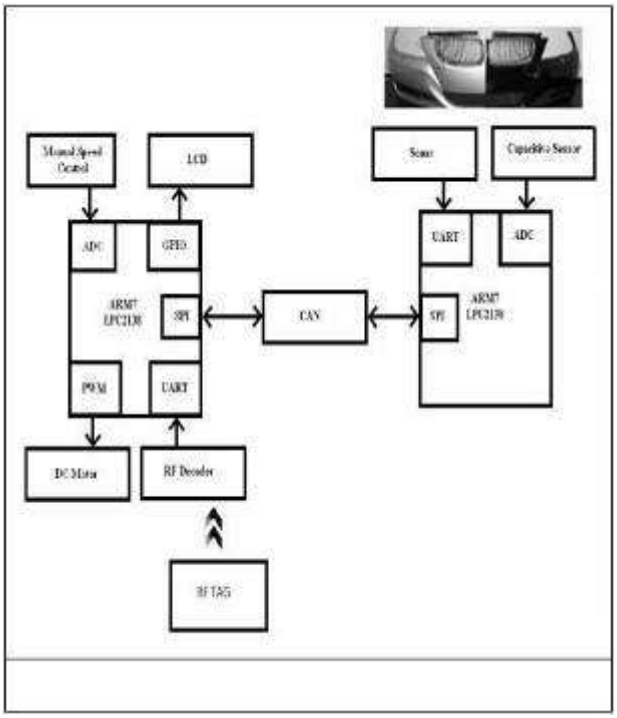


Fig.1: Block Diagram

interruption of the sound beam as the objects pass between the transmitter and receiver. An ultrasonic sensor typically utilizes a transducer that produces an electrical output in response to received ultrasonic energy. The normal frequency range for human hearing is roughly 20 to 20,000 hertz. Infrared sound waves are sound waves that are above the range of human hearing and, thus, have a frequency above about 20,000 hertz[2]. In electrical engineering, capacitive sensing is a technology based on capacitive coupling that is used in many different types of sensors, including those to detect and measure: proximity, position or displacement, humidity, fluid level, and acceleration. Capacitive sensing as a human interface device (HID) technology, for example to replace the computer mouse, is growing increasingly popular. Capacitive touch sensors are used in many devices such as laptop trackpads, digital audio players, computer displays, mobile phones, mobile devices and others [5]. The Controller Area Network (CAN) module is a serial interface, useful for communicating with other peripherals or micro-controller devices. It was standardized in ISO 11898 and ISO 11519, establishing itself as the standard protocol for in-vehicle networking in Europe now. Today, CAN is widely accepted for its high performance and reliability. CAN is a messagebased protocol, designed specifically for automotive applications but now also used in areas such as industrial automation and medical equipment. It is a multimaster broadcast serial bus standard to connect electronic control units.

DMC series is the name given to the dot matrix character LCD display modules that have been developed by OPTREX CORPORATION. The modules consist of high contrast and large viewing angle TN and STN type LC (liquid crystal) panels Each module contains a CMOS controller and all necessary drivers which have low power consumption. The CMOS controller in it is equipped with an internal character generator ROM, RAM and RAM for displaying data.. All display functions are controllable by instructions making interfacing practical.

The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying. Transmission through RF is better thanUS (Ultrasonic) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications. Braking system works with the help of DC motor. It is driven by DC current and it produce high torque and rotates with 886 rpm.

Working:

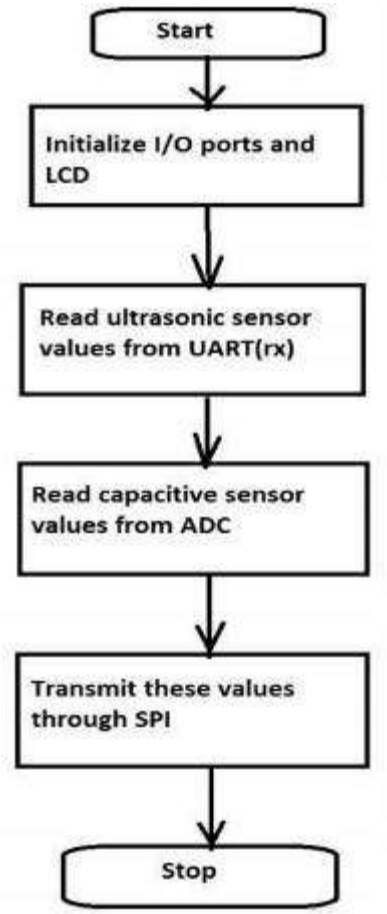
The proposed system exhibits three speed level operations. The first level is the high speed operation, say above

Fig2. Transmitter section

Fig3. Transmit Section

70km/hr. In this case the safety distance that must be maintained in between the vehicle and the obstacle is considered as 4 metres. So if the sensors detect any within this range the brake is applying automatically and the speed is reduced. As the obstacle is moving away the driver can increase speed manually. The second level is the medium speed operation, say between 20km/hr and 70km/hr. In this

case the safety distance that must be maintained in between the vehicle and the obstacle is considered as 1 meters. So if



the sensors detect any within this range, the brake is applying automatically and the speed is reduced. The third level operation comes in the case of

Receiver Section:

parking and heavy traffic conditions. In such situations the speed of the vehicle is usually less than 20km/hr. In such cases the safety distance that must be maintained in between the vehicle and the obstacle is considered as about 20 centimeters. So if the sensors detects any within this range the brake is applying automatically and the speed is reduced. As the obstacle is moving away the driver can increase the speed manually. So the proposed system is very suitable in case of tight parking and heavy traffic conditions. Also the system disables horn automatically and reduces speed automatically in restricted areas.It gives very accurate measurement and also improved short distance measurement also[8].

Software Architecture :

The coding for this system is done by using embedded C. Flow charts for the important software section is given below

Transmitter Section:

In electronic and telecommunication a transmitter or radio transmitter is an electronic device which generate a radio frequency alternating current when a connect a antenna emits radio wavs. in this section infrared and capacitive CAN protocol. The values are transmitted to the reciver section through serial peripheral.

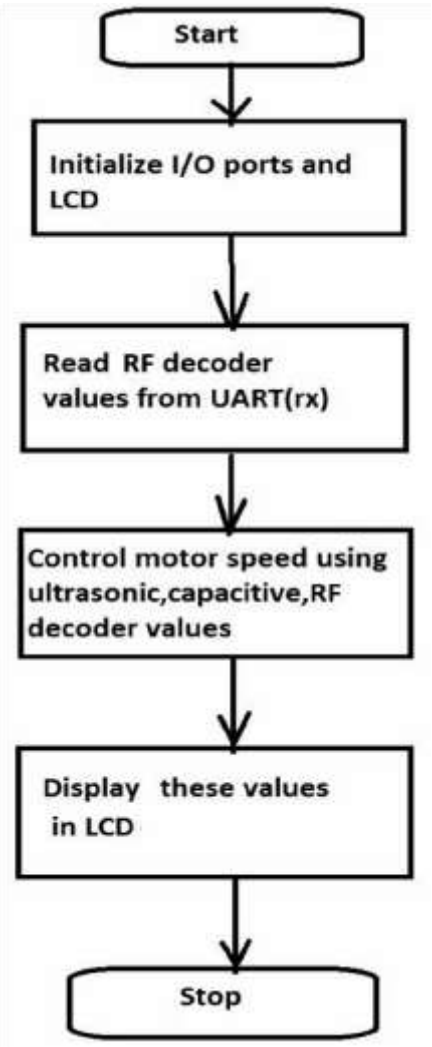


Fig3. Receiver Section

3. RESULT

To check the working of my system,I placed it in a car whose braking system is controlled by a DC motor.I have tested the working of the system in three speed level operation specified above. The system responded by reducing the speed of the vehicle when the obstacle is placed at various distance from it. Also the system disabled horn automatically and reduced speed automatically in restricted areas.It gave very accurate measurement and also improved short distance measurement also.

4. CONCLUSION

This paper represents design and implementation of an Automatic Braking system based on sensor fusion indented to use in vehicles that can solve the problem where drivers may not brake manually, but vehicles can reduce speed automatically due to obstacles. With the fusion of Infrared and capacitive sensors, the resulting system can achieve measuments with high accuracy and improved short

distance measurement also. The system is very suitable in case of tight parking and heavy traffic conditions. The system also exhibits automatic horn disabling and automatic speed reducing in restricted areas. The tests prove that the designed system can satisfy its goals with in the budget limits.

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