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Literature on safety module for vehicular driver assistance

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Abstract: *Automatic Guided Vehicle (AGV) nothing but vehicle guideline provided by capturing images of the road. In this paper we have design an embedded surveillance and safety systems. The system also provides full driver assistance by determining the distance between two vehicles. The lane departure is an improved technique in which lane boundaries are analyzed continuously and will also report to the user as soon as vehicle is try move outside the lane or road. So this system not only helps to provide safety but also helps in reducing the cost which is further considered to be most important factor.*
Keywords: *Automatic guided vehicle, embedded surveillance and Safety system, lane departure*

I. Introduction

Automotive Electronics sector are getting more demand due to use of embedded system for different applications in car day by day. Most of luxurious cars having more automatic controls like Airbags, ABS, ESP, ECU, ESP, climate control and more. Intelligent driver assistance system nothing but provide the full assistance to the driver when drive driving the car on the road along with considering the traffic intensity and white lane detection. Driver assistance is the considered to be important in aspect with security of vehicles. Driving vehicle gives a certain level of comfort to user but does not impart safety to user and hence systems must be introduced to enhance security. In the world of automotive electronics where various systems come in market that ensures safety like real time state monitoring, positioning, emergency services but requires large cost. The use of vision for Intelligent Transportation Systems (ITS) is now widely considered as one of the most convenient perception technologies [5]. Previous work in the ITS shows the involvement of more and more enhanced electronics in the driver assistance though we have mechanical systems such as brakes, airbags etc. The user perception sometimes becomes not as good as technology. Smart objects are aware of their environment, can perceive their surroundings through sensors. The systems are capable of reducing of getting damage in dangerous environment. The use of new enhanced technologies such as sensors with good processing capabilities can able to provide better assistance to user in vehicle. The driver assistance system consists of one sensor module connected to a raspberry pi development board along with 4.5 inches TFT screen. The sensor module used will be ultrasonic sensor module which is capable of transmitting and receiving echoes.

Detecting edges is an important aspect in many areas of applications and is one of the most important problems in image analysis. An edge is defined **as** an abrupt change in the grey level of an image or an edge can be defined as a sudden jump in the state of a signal [6]. The road edges are often marked with white strips to guide the user vehicle. With the help of these strips this system can be able to judge the out boundaries of road. The detection method requires various operators and on the basis of the operator the type of technique such as parallel or sequential are decided. These mention techniques are mentioned in [6] helps us in simplifying the calculation.

A camera is also mounted on car windshield to monitor the upcoming and outgoing cars and that will be monitored by display connected to raspberry pi board. The assistance provided by this system delivers safety to vehicle by anti-collision and lane departure system. Anti- collision system uses camera mounted on windshield of car to monitor vehicles that are very close to user vehicle and simultaneously using ultrasonic sensors to determine the distance between these two vehicles. When undesired vehicle try to make collision with user vehicle, it will make a sound to alert the user in this vehicle. Further, a lane departure system is introduced in which camera also used to monitor the side boundaries of the road or lane and make aware the user in this vehicle when vehicle is moving off road.

II. Structure And Principle

The system consists of web camera of 2.0 VGA which is used to capture video. The camera is mounted on the windshield of the vehicle so to take the vehicle moving in front of user vehicle. The camera has an USB interface with Raspberry Pi model. There are various types of camera available in market but cost effective manner we are using web camera. The Raspberry Pi is special type of development board of very small dimension 12.2 x 7.6 x 2.4 cm and The secret sauce that makes this computer so small and powerful is the Broadcom BCM2835, a System-on-Chip that contains ARM1176JZFS with floating point, running at 700Mhz,

and a Video core 4 GPU. The results will be shown on LCD screen or TV screen which provide a level of flexibility to programmers. The programmers also given reliability in terms platform the Raspberry Pi uses Linux kernel. The type of Linux Operating System on which it runs is Raspbian. The Raspbian can be easily dumped on the flash card and inserted on the development board of Pi. Further command Raspbian has its own command prompt named as LX terminal and user doesn't need to use additional software to dump the program into the development board and check the results periodically. The inputs can be given with the help of USB interfaced keyboard as well as USB interfaced Mouse. Both the hardware units (keyboard and Mouse) run instantly as attached to the development board when system is on. An ultrasonic sensor is also interfaced through GPIO (General Purpose Input Output) pins with the development board. The sensors are used to detect the upcoming vehicles if they are in range close to the user vehicle. The ultrasonic sensors used in this system is having range of 1feet approximately equals to 12 inches. The ultrasonic sensors used having two parts transmitter and receiver for transmission and reception of signals. The echoes to be send from transmitter by using high frequency oscillator and the reflected echoes of the object are received by the receiver. All these circuitry or firmware needs to be updated before the system load all its input and output peripherals and also need power supply of 3.0 w.

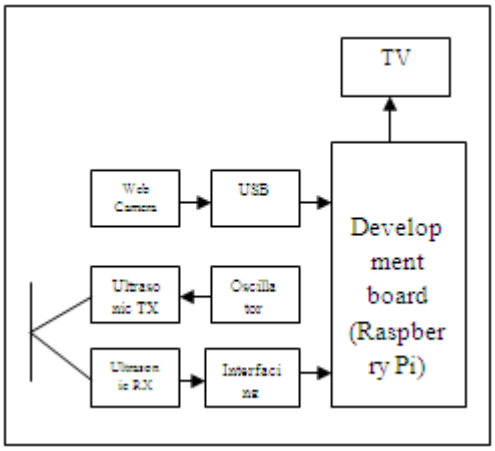

Fig 1: Block Diagram of System

III. Hardware Component

The hardware components are shown in above figure is mentioned below:

1. **Ultrasonic Sensors**

The work of the ultrasonic sensors in the field of robotics is adorable based on application such as the measurement of the proximity of objects [7]. The Parallax ultrasonic distance sensor provides precise, non-contact distance measurements from about 2 cm (0.8 inches) to 3 meters (3.3 yards). It is very easy to connect to BASIC Stamp® or Javelin Stamp microcontrollers or other development boards. The sensor works by transmitting an ultrasonic (well above human hearing range) burst and providing an output pulse that corresponds to the time required for the burst echo to return to the sensor. By measuring the echo pulse width the distance to target can easily be calculated. The time-of-flight (TOF) information of the transmitted pulse is used for the calculation of distance between two vehicles [1]. Surface profile determination by spatial voting and target classification by multiple reflections were studied with the help of intelligent processing of TOF measurements and necessary calculations are done. By multiplying the time between pulse and echo t (in seconds) with speed of sound c, you will get twice the distance d to the object in meters (since the sound travelled the distance twice to get to the object and bounce back).

$$d = \frac{c.t}{2}$$

The accuracy of the distance measurement is directly proportional to the accuracy of the speed of sound used in the calculation. The structure and type of ultrasonic sensor used is shown in figure below:

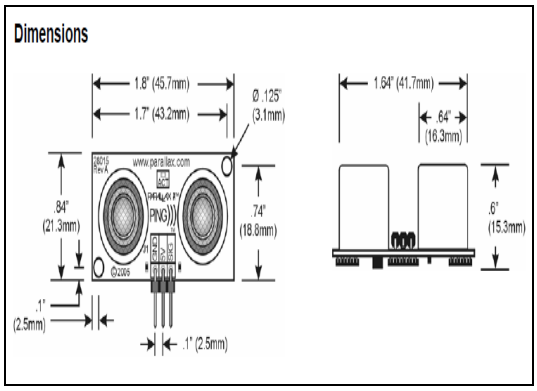

Fig 2: Dimensions of Ultrasonic Sensor

1.1 Features

• Supply Voltage – 5 VDC
• Supply Current – 30 mA typ; 35 mA max
• Range – 2 cm to 3 m (0.8 in to 3.3 yrds)
• Input Trigger – positive TTL pulse,
2 uS min, 5 µs typ.
• Echo Pulse – positive TTL pulse,
115 uS to 18.5 ms
• Echo Hold-off – 750 µs from fall of Trigger pulse
• Burst Frequency – 40 kHz for 200 µs
• Burst Indicator LED shows sensor activity
• Delay before next measurement – 200 µs

As per the figure the dimensions of the ultrasonic sensors are shown which are – 22 mm H x 46 mm W x 16 mm D (0.84 in x 1.8 in x 0.6 in).

1.2 Theory Of Operation

The sensor detects objects by emitting a short ultrasonic burst and then "listening" for the echo. Under control of a host microcontroller (trigger pulse), the sensor emits a short 40 kHz (ultrasonic) burst. This burst travels through the air at about 1130 feet per second, hits an object and then bounces back to the sensor. The sensor provides an output pulse to the host that will terminate when the echo is detected; hence the width of this pulse corresponds to the distance to the target. The distance between the object is calculated by equation given above.

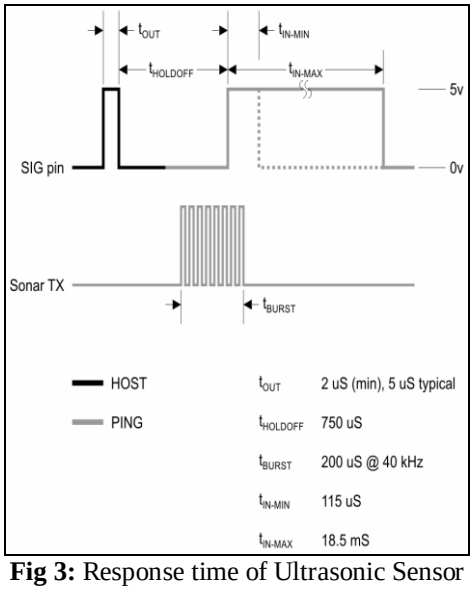

Fig 3: Response time of Ultrasonic Sensor

1.3 Test Data Overview

The test data on the following pages is based on the sensor, tested in the Parallax lab, while connected to a BASIC Stamp microcontroller module. The test surface was a linoleum floor, so the sensor was elevated to minimize floor reflections in the data. All tests were conducted at room temperature, indoors, in a protected environment. The target was always centered at the same elevation as the sensors.

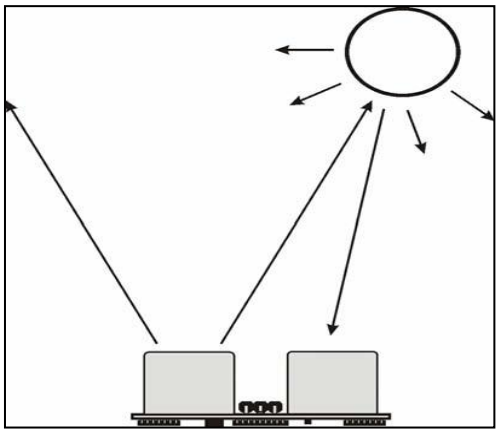

Fig 4: Detection by Ultrasonic Sensors

2. Camera Module

VGA web camera of 0.3 megapixels is used. The VGA camera can able to give an image of resolution of 640*480 pixels. The development board support broad range of standards in terms of megapixels but due to performance constraints and cost issues we have used VGA camera of 0.3 megapixels. The frame rate of the camera is set at 30 fps. The camera is used for the surveillance and edge detection system.

3. Raspberry Pi

The model used for the raspberry pi is model B+ which named as BCM2835. The development board is the heart of the system and consists of BCM Audio-Video codec for the GPIO and having ARM 11 processor with frequency of 700 MHz .The structure of Raspberry Pi model is shown in figure below:

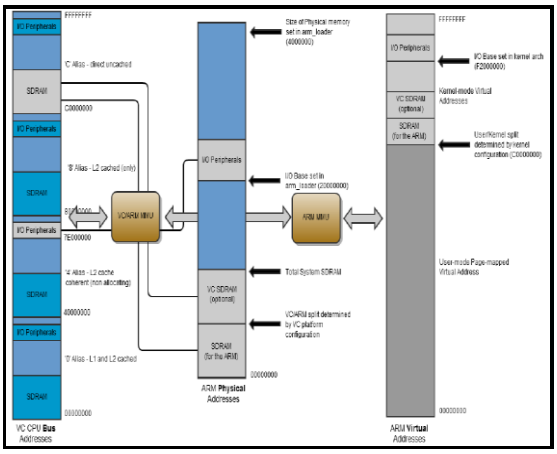

Fig 5: Diagrammatic overview of Raspberry Pi

2.1 Overview

BCM2835 contains the following peripherals which may safely be accessed by the ARM:

- Timers
- Interrupt controller
- GPIO
- USB
- PCM / I2S
- DMA controller
- I2C master
- I2C / SPI slave
- SPI0, SPI1, SPI2

• PWM
• UART0, UART1

3. Indicators

The indicators are used basically to notify the person sitting inside the car that weather the other vehicle is near or far to the user vehicle. The status of the indicator is shown by the LED blinking and with a sound of alarm if moving outside the lane.

4. Lcd Screen

The LCD screens are used to monitor the front side of the vehicle. They are also playing major role in displaying the distance between two vehicle calculated by ARM processor with the help of ultrasonic sensors.

IV. Software Implementation

The programs in raspberry pi model are executed in LX terminal which is a command prompt for Linux kernel. The programming language used is python which cannot be able to execute the programs directly and need to install some packages as follows:

1. Installation Of Packages

The installation packages are nothing but the libraries in the python which need to be updated and installed before starting any executions. They include libraries such as libraries for peripheral devices like camera, video player, codec libraries etc. The commands for these libraries to access are as follows:
$sudo apt-get install python, $sudo apt-get install update, $sudo apt-get install fswebcam, $sudo service motion stop/start, $sudo Ifconfig, $sudo lsusb.

All the above commands are required for the configuring python libraries, installing updates, installing drivers for camera, to start or stop camera service, to check transmission and reception of data and status of the peripheral devices connected to the development board.

2. Image Capture From Webcamera

After that we can capture the image from the camera by using some commands. The command uses fswebcam library to access the camera of video type YUYV of resolution 480*640 pixels. The name of image is saves as camera1 with (.jpg) extension and the image is stored in place specified in the command line address.

V. Conclusion

The raspberry pi development board is an efficient circuit with greater capabilities and can fulfill the operations satisfactorily required for the driver assistance system. The circuit works efficiently with other peripherals like camera and is basically designed for real-time applications. This system works with anti-collision system and lane departure system for the safety of the vehicle in crucial traffic conditions. In future work, a GPS module can be added to the circuit to periodically notify the user status when in problem to the nearest control room. The driver assistance have broad sense of application and this project only implements a part of that but the most important thing is, it reduces the fabrication cost of the system which will be 3-4 times more when used by other development board.

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