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Automotive Collision Avoidance System

A.Deepak[1], M.Sriramprasath[2], R. Lokesh, M. Sarath Kumar

ABSTRACT: *Road safety has become a major social issue with the number of cars and trucks increasing day by day. This project focuses on development of a crash warning and avoidance system that monitors the environment of the vehicle constantly and assisting the driver in avoiding a collision. This idea targets a low cost, retrofit scheme which can be used in Indian roads to prevent the worst case scenarios in road crashes. This system incorporates an ARM based processing unit running RTOS which uses a camera to detect a crash scenario and send control signals to corresponding Electronic Control Units.*

I. INTRODUCTION

Road traffic accidents (RTAs) had become an important factor in public health and development problem in India. RTAs involve high percentage of damages in human life in various levels. Although there are various measures had been taken to reduce accidents[1]. A survey by ministry of road transport & highway in 2010 reports around 5 lakh accidents in India in which 1.3 lakh people were dead and 5.2 lakh were injured. RTAs Kill almost 1.2 million people a year and injuring or disabling between 20-50 million people around the world. This clearly shows the importance of a crash prevention and avoidance systems in today's automotive industry.

This project aims to create a low cost, retrospective solution that can be implemented in large scale to help reduce a significant number of accidents. This is by no means a fully autonomous system as it is, but an effective driver assistance system which helps the driver use an automobile in a safe way without getting into a crash situation from which the driver may find it hard to get out of. The system can also help a panicking driver to safely get out of the crash scenario. This system contains two levels of assistance, the first level being a driver alerting system followed by a controlled braking process.

CRASH SCENARIO CLASSIFICATION

Classification	Legend
Loss of control approaching a corner	C1
Night time collision with parked vehicle	C2
Collision of Car approaching a junction	C3
Preceding vehicle Decelerates	C4
Crossing Obstacle/ pedestrian/ animal	C5
Preceding vehicle shifting lanes	C6

Table1- Crash Scenario Classification

An effective solution comes from an effective problem analysis. Here we first analyze road traffic highway accidents and categorize them under 6 abstract collision classifications which account for a major number of crashes. All basic conceptual design was made based on these six classifications.

BRIEF SURVEY OF EXISTING SYSTEMS

A survey of the existing systems helps in choosing the right combination of hardware that may be required to achieve a sufficiently accurate system.

Comparison of Crash scenarios addressed by different ADAS systems

Category	Name	Warning*	Braking*	Steering Assist*	Description
Existing	Nissan Collision Avoidance	C2, C4, C5, C6	C2, C4, C5, C6	C2,C4,C5,C6	State of art ADAS (up to 37 mph)
	Toyota Pre collision System	C2, C4, C5, C6	C2, C4, C5, C6	None	Targets Basic safety
	Mercedes collision prevention assist/ Drivetronic +	C1, C2, C4, C5, C6	C1, C2, C4, C5, C6	None	Emergency Driver assist function
	BMW Lateral Collision Avoidance	C1, C6	None	None	Targets Lane change warning
	Volvo Collision Control System	C2, C4, C6	C2, C4, C6	None	Low speed (<19 mph)
	Honda Forward collision Warning	C2,C4,C6	None	None	Warning system to alert driver
Proposed	Collision Warning and Assist System	C1, C2, C4, C5, C6	C1, C2, C4, C5, C6	None	Warning followed by assist

Table2- Survey of Existing System

EXPERIMENTAL SETUP

The system architecture of the proposed solution is shown in the figure below. It consists of an ARM controller (Raspberry pi system),[2] a onboard USB camera, LCD display and other I/O interfaces.

SYSTEM ARCHITECTURE

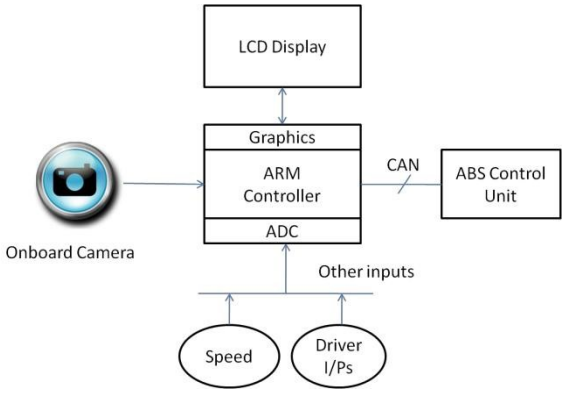

Fig1- System Architecture

HARDWARE: DISPLAY

Portable display helps in driver assistance and alerting. The display is powered by 12v battery. It is connected to Raspberry Pi using RCA connecter.

The display is of 9 “inch with various feature AVI mode Sdcard mode FM mode etc.

Fig2- Display

RASPBERRY PI SYSTEM

The Developer is Raspberry Pi Foundation and type Single-board computer. Release date 29 February 2012. The supported Operating system are Linux (Raspbian, Debian GNU/Linux, Fedora, and Arch Linux ARM)[2] RISC OS, FreeBSD, NetBSD, Plan 9. The Power rating is 2.5 W (model A), 3.5 W (model B).

The processor ARM1176JZF-S (armv6k) 700 MHz Raspberry Pi can dynamically increase clock speeds, and some can temporarily reach speeds up to 1 GHz. It has an internal Memory of 512 MByte (Model B rev 2). And a Broadcom Video Core IV Graphic processor.

Fig3- Raspberry-pi

WEBCAM

SOFTWARE:

The software used includes a server-client VNC software package on the raspberry pi[3][4] and the laptop for terminal and XDesktop access through a network. Opencv builds in the raspberry pi and GPIO support packages are used at programming level to use the functionality available in the board.

PACKAGES CAN protocol

Controller Area Network (CAN)[5] was first introduced by German automotive system company Robert Bosch in the year of 1980s for automotive applications as it uses robust serial communication for automotives. The aim was to make automotives more safe, reliable and fuel-efficient this system is found. This is not the only need of CAN while it decreasing wiring harness weight and complexity.[6] Due to this the CAN protocol has gained wide spread name in industrials of automobiles and automotive/truck applications. Other markets where networked solutions can bring attractive benefits like medical equipment, test equipment and mobile machines are also starting to utilize the benefits of CAN.

GPIO packages

A module to control Raspberry Pi GPIO channels. It is a configurable I/O lines, this package provides a class to control the GPIO on a Raspberry Pi.[7] GPIO are very simple, a group of pins that can be switched as a group to either input or output. That is each pin can be set up flexibly to accept or source different logic voltages, with configurable drive strengths and pull ups/downs. The input and output voltages are typically, though not universally limited to the supply voltage of the device with the GPIOs on, and may be damaged by greater voltage.

Programming Arch

In this raspberry pi is the system which has various peripherals like camera input and VNC [8](Virtual Network computing) for wireless access system. It uses python code for process in an Linux Kernel (OS) [9]for various processing like Edge detection and object detection in image processing using Open CV libraries files. In his I/O drivers and packages are GPIO and File I/O.

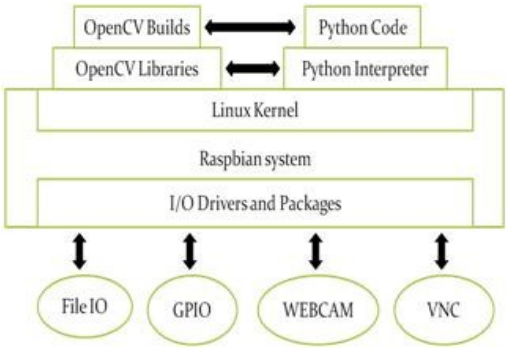

Fig4- USB Webcam

3 MP cam is used for live video processing this input is directly connected to the raspberry pi system using USB. The webcam consist of 12x optical zoom and direct avi format video as output at the pi end. This video files are accessed using Open CV library package in PI system.

II. RESULTS AND DISCUSSION

IMAGE PROCESSING RESULTS

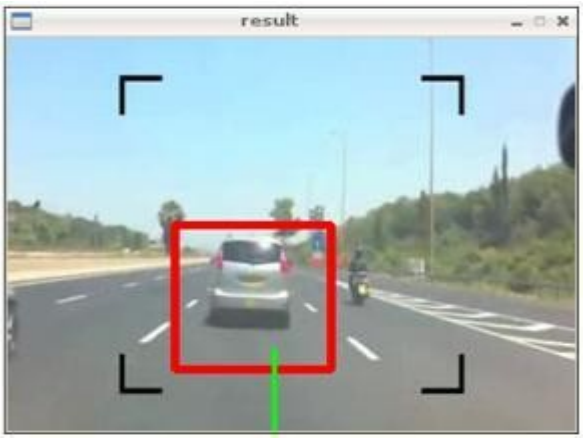

Fig 6 Object Detection Image

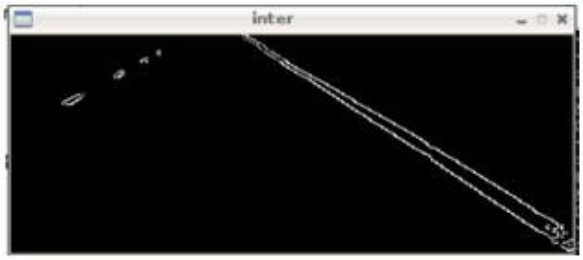

Fig7- ROI Lane

Fig8- Lane Detection

III. CONCLUSION

The main advantage of our system is low cost implementation. The system is Retrofit (for all cars already on road).[3] This system is easily implementable in low end cars. And the targets in this project are most frequent crash scenarios on Indian roads. This system contains effective functionally modular. The main disadvantage of this system is the term accuracy and noise

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