Embedded Vision Based Driving Assistance System for Safe Driving With Road Accident Detection and Reporting

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Abstract- *Automated driving will have a great impact on society, creating new possibilities for mobility and reducing road accidents. The presence of vision technologies inside the vehicles is expected to grow as an increase in the automation levels. However, embedding a vision-based driver assistance system supposes a major challenge because of the special features of vision algorithms. Additionally, some outstanding challenges are also identified. A learning algorithm (Machine learning classification algorithms) is used to optimizing solution. This paper mainly concentrated on vision-based driving assistant system using computer vision and post-crash analysis using a black box.*

Keywords- Advance driving assistance system (ADAS), Lane departure warning system (LDWS), Forward collision warning system (FCWS) and Post Crash Analysis.

I. INTRODUCTION

Using transportation is an everyday practice, a characteristic of the modern world, but the human role is basically taken for granted. People are using different transportation modes such as cars, buses, trains, ships or aircraft. From all these modes of transportation, road traffic injuries are consistently one of the three causes of death for people aged between 5 to 44 years old. More than 1.2 million people died on the world's roads every year, and as many as 50 million others are injured [1].

The major role of computer vision in understanding and analyzing the driving scene is of great importance to building more intelligent driver assistance systems. However, the implementation of these computer vision-based applications in a real automotive environment is not straightforward. The vast majority of works of the scientific literature test their driver assistance algorithms on standard PCs. When these algorithms are ported to an embedded device, they see their performance degraded and sometimes they cannot even be implemented. Since there are several requirements and constraints to be taken into account, there is a big gap between what is tested in a standard PC and what finally runs in the embedded platform. Furthermore, there is not a standard hardware and software platform, so various solutions have been proposed by the industry and the scientific community, as it is usual on still non-mature markets.

To help reduce the huge casualty, tremendous innovations in driver assistance systems are on the horizon, including Lane Keeping Systems (LKS) [2] and Lane Departure Warning Systems (LDWS) [3]. Among these, camera-based lane detection [4] has been a core technology which many of the newer driver safety systems adapt. Lane marker detection recognizes white or yellow markings from the image captured by a camera mounted in the car to provide lane position for automating driving systems [4].

II. PROPOSED SYSTEM

This project mainly concentrated on a vision-based driving assistant system using computer vision. One of the key technologies in this project is advanced driver assistance systems (ADAS). Safety features are designed for avoiding collisions and accidents by using driving assistant technology that alerts the driver of potential dangers or by implementing safeguards

The proposed system mainly consists of three parts as follows.

A. The vision-based driving assistance system
B. Road accident detection and reporting system using IoT
C. Post-crash analysis using the Black box

A. The vision-based driving assistance system

An embedded vision system for driving assistance need to be fulfilling trade-off between several requirements such as dependability, real-time performance, low cost, small size, low power consumption by considered all these factors this system is designed. This driving assistance system mainly concentrated on three parts: 1. Lane Departure Warning Systems (LDWS); 2. Forward collision warning system (FCWS); 3.Traffic signs recognition. Entire Vision based driving assistance system access the data from the camera and performing basic image operation by using Open CV (an open source computer vision library). Lane detection is basically to identify the margin of the road by using edge detection. Coming to FCWS objected are identified and opposite vehicle distance is calculated. Object identification and traffic signs recognition are performed by using machine learning.

1. LDWS

At the time of ignition of the vehicle, camera accessed and edge detection and filters are performed on each frame of video. We considered region of interest as trapezoid. During processing of frames huge noise is produced and unnecessary lines are produced several considerations are taken to eliminate them and detect straight lines.

$$y = \frac{1}{2}Cx^2 + mx + b \qquad (1)$$

Where c is the curvature of the lane, m is slop, b is offset of the lane, x and y are coordinate values

Based on slop value a condition is performed if slop is more then 80 or less than -80 intimate vehicle driver by generating audio "you are crossing lane" from the speaker.

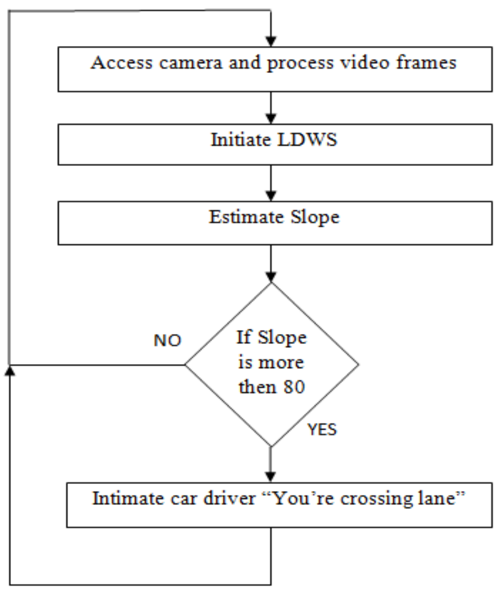

Fig. 1 Flow chart for lane detection

***2.** FCWS*

Identifying the object is itself is a big task a learning-based algorithm is used to identify objects. Support Vector Machine (SVM) is used to classify objects based on obtained features from the camera. Lighting condition and weather condition have a greater impact in obtaining futures. This will be corrected by applying filter maintain different threshold levels. Distance is estimated based on size and shape of the vehicle and there relative pixel values, FCWS flow chart given in Fig 2 in this assistance to driver performed if the distance is less than 10 meters and generate an alarm signal by the buzzer at the same time a audio "you are nearby a vehicle".

3. Traffic signs recognition

Indian Traffic signs are trained using neural networks algorithms. Each and every traffic sign images are taken in different light conditions and images are trained based on their labels. There are several proposing steps are considered like image colour segmentation. Attain reason of interest and classifying using multiple neural networks after these proposing steps intimate driver about traffic sing as explained in Fig. 2 and respect audio generated for respected sing to intimate.

B. Road accident detection and reporting system using IOT

Road accident is detected by impact switches [7], this are placed in the front, back, both sides of the car. During accident huge pressure occurred on impact switches then it said to be accident occurred according to proposed system in such a case immediately the location of the accident and vehicle number are sent to concern authority likes ambulance, police etc., by using IOT simultaneously a continuous RF signal is transmitted after the accident occurred this will help full to identify the vehicle.

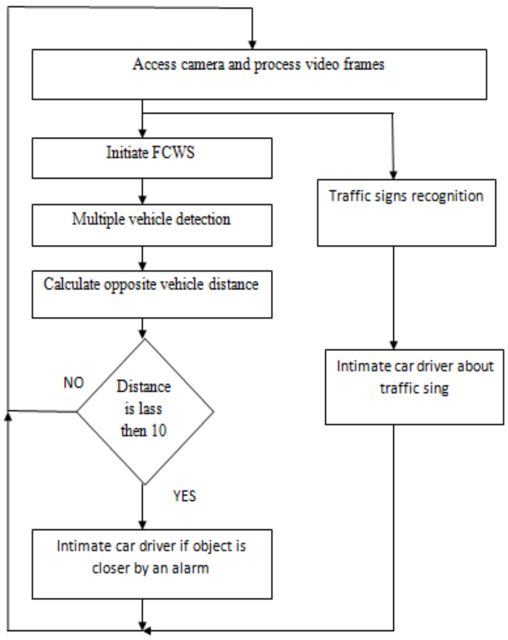

Fig. 2 Flow chart for FCWS and traffic sign recognition

C. Post-crash analysis using Black Box

The Post-crash analysis main aim is to identify, how the crash occurs? It collect data from the sensor will be tack care of Arduino to reduce the burden to raspberry pi because Vision based driving assistance system itself required a huge amount of computation power. It collects data from humidity, temperature, gyro and accelerometer sensors and transformed to raspberry pi through the serial port. Change in Gyro values means change rotation motion similarly change in accelerometer means a change in axial motion. When the accident occurred then sensor data sent to concern mail-id using IOT [6]. Fig.12 is line chart for Black Box information this will help to identify crash analysis [8].

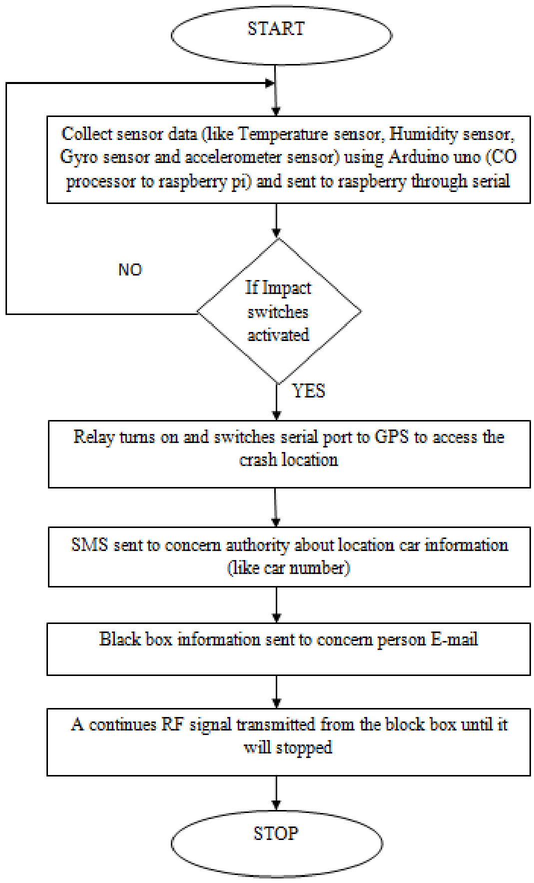

Fig. 3 Flow chart for road accident detection and reporting

III. HARDWARE

Hardware architecture consists of Raspberry Pi which is the main part of entire hardware architecture used for performing driving assistance. We consider sensors such as temperature, humidity, accelerometer and gyro sensors. These sensors are connected to the arduino. Here, accelerometer and gyro sensor data used to identify a change in orientation and rotation based placemat of the vehicle. Temperature and humidity sensor is used to identify internal vehicle temperature conditions.SD card contains OS and file system. It is inserted in the SD card slot. Impact switches nothing but vibrating sensor. If impact switch is activated then road accident is detected. The camera is directly connected to the raspberry pi. Speaker and buzzer are used to intimate vehicle driver. Speaker is directly connected to 3.5mm audio Jake. Raspberry Pi HDMI port connected to display. GPS and arduino both are connected to the serial port.

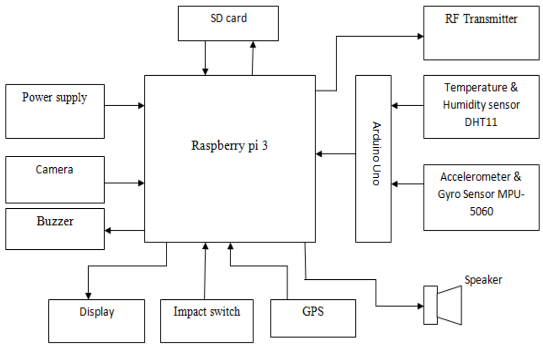

Fig. 4 Hardware architecture

IV.SOFTWARE ARCHITECTURE

The software architecture itself explanative to understand. How entire software organized? Object detection and traffic sign are trained on hardware by using Support Vector Machine (SVM). Training, validation and testing is done on image data set which contains Indian traffic sign and vehicle images. Coming to operating system standalone not necessary due to memory constraints and computational ishues. If background applications of os are ruing then the performance of vision algorithms are reduced due to them by considering all this a basic kernel with required support to application of OS is enough due to this constraint.

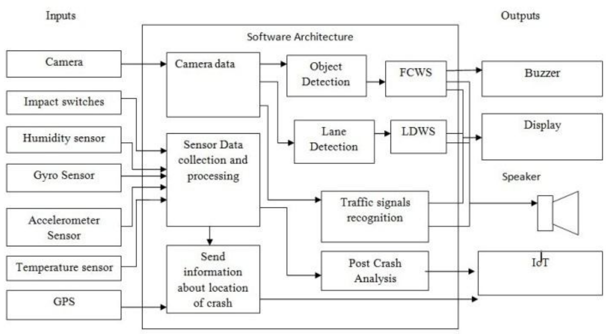

Fig. 5 Software architecture

V. RESULTS AND DISCUSSION

There is no ideal platform for implementing vision-based algorithms for embedded applications, it varies with graphics processing. Some of the most commonly used embedded platforms are not much faster as real-time for the vision system. We required an efficient platform to built high computation performance. Raspberry is also not much sufficient to perform these operations but several considerations are taken to obtain higher efficiency such as dynamic threshold and splitting entire image training data set into Batches and trained one by one. The proposed system can achieve 89.34% detection rate and 3.4% of false alarm rate on average in FCWS and Traffic Sign Detection. Design, development and validation we follow a V-model [4]. Testing was done on two aspects testing using test dataset and testing on public roads. Fig. 6, 7 and 8 are related to vision-based driving assistance system testing on highway roads.Fig.9 SMS intimation to concern authority in case accident occurred. Table I is Black box information sent to concern mail id after the accident occurred it contain time, date, humidity, temperature, accelerometer (Ax, Ay and Az) and gyro meter (Gx, Gy and Gz) sensor values. Fig 10 is related to line chart for this sensor values.

Fig. 6 Lane departure warning system

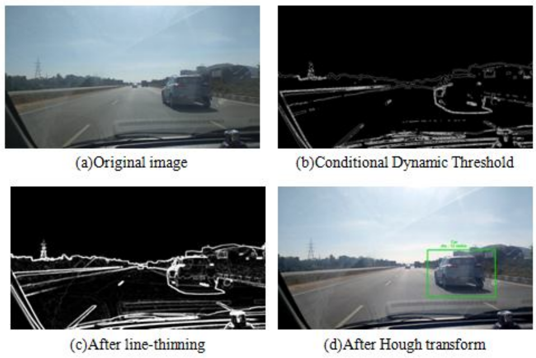

Fig. 7 Forward collision warning system

Fig. 8 Traffic signs recognition

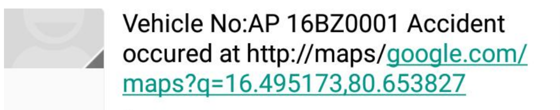

Fig. 9 SMS intimation to concern authority

TABLE I
Black box file

DATE and TIME	H	T	AX	AY	AZ	GX	GY	GZ
18/01/2018 - 15-39-13	46	26	1256	-296	19216	-251	46	54
18/01/2018 - 15-39-24	46	26	1344	-208	19352	-261	14	41
18/01/2018 - 15-39-25	46	26	1320	-272	19316	-224	20	50
18/01/2018 - 15-39-27	46	26	1280	-288	19148	-264	9	-46
18/01/2018 - 15-40-19	46	26	1308	-180	19300	-248	9	-35
18/01/2018 - 15-40-30	46	26	1344	-284	19332	-250	27	-67
18/01/2018 - 15-40-30	46	26	1300	-132	19376	-251	33	-51
18/01/2018 - 15-40-33	46	26	1280	-220	19284	-238	6	-48
18/01/2018 - 15-40-35	46	26	1276	-140	19196	-248	24	-61
18/01/2018 - 15-40-37	46	26	1336	-140	19260	-255	33	-41
18/01/2018 - 15-40-40	46	26	1348	-148	19216	-273	39	-52
18/01/2018 - 15-40-42	46	26	1380	-236	19344	-253	13	-31
18/01/2018 - 15-40-44	46	26	1324	-136	19380	-227	-3	-53
18/01/2018 - 15-40-47	46	26	1304	-136	19484	-259	25	-53
18/01/2018 - 15-40-49	46	26	1396	-152	19288	-257	-9	-36
18/01/2018 - 15-40-51	46	26	1332	-216	19372	-265	-7	-67
18/01/2018 - 15-40-54	46	26	1336	-252	19352	-269	29	-34
18/01/2018 - 15-40-56	46	26	1336	-232	19168	-245	-1	-55
18/01/2018 - 15-40-59	46	26	1404	-196	19092	-251	14	-43
18/01/2018 - 15-41-01	46	26	1232	-360	19232	-259	60	-47

Fig. 10 Line chart for black box information

VI. CONCLUSION

This paper provided an insight into vision-based embedded ADAS. The key elements of this field were explained, starting from the features and requirements that these systems have. These features and requirements guide all decisions taken about hardware and software. The balance between the three levels of processing of the implemented vision algorithm (low level, mid-level and high level), is of big importance when designing both the hardware architecture and the finally optimized software. It is also remarkable that it is not possible to fulfill completely all the requirements, so there must be a trade-off between the several design requisites.

In this paper, an ADAS consisting of FCWS and LDWS functions is proposed and implemented on a Free scale with a monocular camera, which provides safety information to drivers. The proposed dynamic threshold method conquers the problems resulted from different weather conditions, and the proposed multiple frame approval reduces the effect of different scenes and windshield wiper. Two algorithms, LDWS and FCWS, are integrated together in order to produce vision assistance for day and night highway driving, which detects not only the forward vehicle but also the potential cut-in vehicles. Automatic visual inspection systems can assist the human inspector but cannot replace or duplicate many of the unique abilities which the human being has. In this paper, the principle benefits of visual inspection systems help to identify lane, traffic signs, and object classification. This project is mainly to improve the feature of middle range cars and safety of passengers.

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