# Build and Integrate Perception Features on Freescale Platform

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**Abstract -** *The automotive industry is growing rapidly day by day to increase the safety of a human on the road. Among many technologies in automotive industries, the main important technologies are ADAS (Advanced Driver Assistance System) and ITS (Intelligent Transport System). In this project, Lane departure warning and vehicle detection is carried out using S32V234evb.This Lane departure warning and vehicle detection are the functionalities of the ADAS. It uses electronic components to make driver safe by guiding on road through warnings, signals etc. So, integrating these two functionalities into single Freescale platform and optimizing the algorithm.*

*Key Words*:  **ADAS, LDW, ITS, S32V234evb, S32DS vision IDE.**

## 1.INTRODUCTION

In earlier days, the means of transport was the bullock carts, Horse cart, etc. After many years, public transport was introduced for travelling one place to another, which many people will prefer. So, as the economic growth increase in a country, the people have opted for their own transport like bike, car, etc. And for commercial purpose, many vehicles are used to transport goods from one place to another.

Many people are shifting from villages to cities for their daily wages, to work in industries, etc. Population in the cities are increasing which have effect on people using their own vehicles on the road, leading to increase in traffic. Due to increase in traffic, there is an increasing rate in casualties taking place. And even on the highways, many accidents are happening. The reason for the casualties is the knowing or unknowingly happening mistakes by the driver or the vehicle system. Many automotive manufacturing companies are present where the production rate is increasing due to increase in buyers and demand on vehicles. So, for the driver safety on the roads, many researches are going on and many technologies are implemented, new technologies success rate is increasing after implementation in vehicles.

In the new technologies, one of the main technology which is trending and increase in success rate than the failure rate is the ADAS technology.

## 1.1 ADAS (Advanced Driver Assistance System)
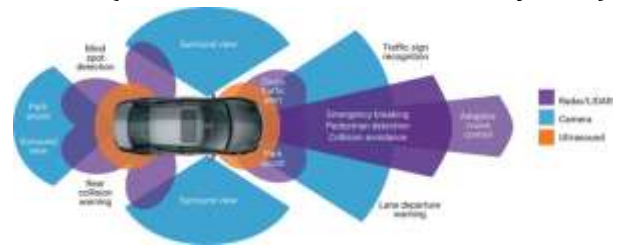


**Fig-1**: Indicates the ADAS technology implementation in car and functionalities of the ADAS.

To prevent the rate of casualties occurring on road, mechanical parts are connected through electronic parts. Here sensors play a major role in ADAS. Camera is the main part and eye of the ADAS system. Functionalities of ADAS will guide the driver on the road and takes over the control if the driver fails to take actions. Along with the Camera, Radar/LiDAR, ultrasound etc. are the major parts of the ADAS technology. The main idea behind the ADAS is the human system interface, which keeps the driver, vehicle safe on road. To prevent the casualties occurring due to human error, this ADAS technology have been implemented. To enhance the existing technology, automate, adapting the technology are the key features to achieve the success rate in ADAS.

There are 5 levels in ADAS, they are as follows:

Level 0: No automation, where the driver performs all the driving tasks.

Level 1: Driver Assistance are the features that are included in the car system, which assist the driver during few situations.

Level 2: Partial Automation, which mainly deals with the acceleration and steering. The driver should be aware and alert about the environment and should be monitoring every time and must be performing the driving tasks.

Level3: Conditional automation, here the driver should be inside the car and must be ready for the alert message or the notice to take the control of the car. But, driver can be relaxed by not monitoring the environment.

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Level 4: High automation, where the driver can be relaxed and vehicle can perform all the driving tasks automatically, but driver can take control whenever required.

Level 5: Full Automation, here the complete driving work will be done by the vehicle, driver can sit comfortably without the problems. Driver can take the control whenever required.

The ADAS consists of different functionalities like LDW, forward collision warning, blind spot detection, cruise control etc. which is added in many vehicles like Audi cars, BMW cars etc. In this project, the main focus is on to the LDW and vehicle detection and these two are the functionalities of ADAS. Normally, LDW and vehicle detection lies in the level 2 and level 3 of ADAS.

## 1.2 Lane Departure Warning

The LDW system is used to warn the driver when the vehicle departs the lane unknowingly. This change of lane occurs due to drowsiness, using the phone during driving, or due to loss of concentration on the car etc. So, during such situation the ADAS system will alert the driver and guide the driver through visual warnings or through the audio warning. In visual warnings, the lanes will be detecting and which will be green in color and if the lane departs then that green color will turn to red color and alerting the driver though visuals.

## 1.3 Vehicle Detection

Vehicles will be detected ahead though the camera, detected vehicles will be represented through the bounding boxes. This technology of vehicle detection can be applied in many applications of ADAS like forward collision warning, blind spot monitoring etc.

## 2. Related Work

In [1], it describes about the implementation of Lane departure warning system using TMS320DM6437 where different operators are used for detecting the edged, lines, lanes and ROI is selected for performing the operations on that particular area.

In [2], it describes about the lane departure warning using the one forward looking camera where CRAL (Changing Rate of Angles between the Lanes) and TLC (Time to Lane Cross) are used and the result describes that, vision based LDW provides the warning when lane change occurs.

In [3], it describes about the implementation of LDW using embedded system and processing the video using video and image processing platform. This system is tested in real time environment and verified.

In [4], it describes about the lane detection and vehicle detection in real time using the different algorithms, Different graphs are generated for different outputs, verified and validated.

In [5], it describes about the concept of Mixture of Gaussian and support vector machine and its application in detection of vehicles and classification of detected vehicles data for traffic analytics.

In [6], it describes about the implementation of lane departure warning algorithm on dual core DSP processor and it contains the HDR CMOS camera for capturing the video of real time and the captured video to undergo video processing to detect the lane which the vehicle has crossed and give a visual warning for the driver.

In [7], it describes about the mobile lane departure warning system where inbuilt camera is used for capturing the lane. The algorithm is downloaded into the mobile for processing the real time captured video and detect the lanes. This system is placed backside of the rear view mirror. It works with high accuracy of detection.
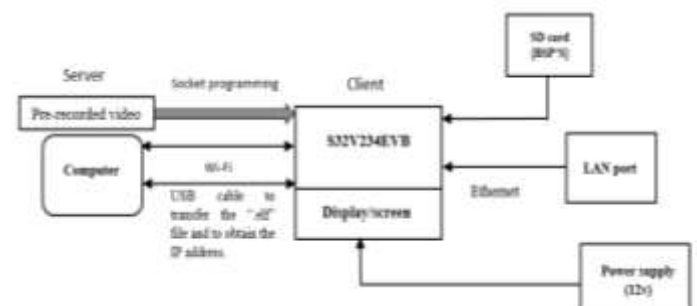
## 3 Block Diagram and Methodology



Fig-2: indicates the block diagram of the project

The Components required for this project are:

a) **Evaluation board**: S32V234 evaluation system and development platform.
b) **Operating system**: Linux
c) **Board Support Packages**: Latest BSP from NXP for Linux.
d) **Software**: S32DS vision

Steps involved in implementation:

a) Preparing the SD card for the boot with Linux Board Support Packages.
b) Writing the C code for transferring the video from the server (Computer) to the client (S32V234evb).
c) Study on the hardware and connection between the S32V234evb and Computer is established.
d) Creating the three tasks where the first task is used to receive the video, second task is used for running

the algorithm, and third task is used for running the video on the S32V234evb.

e) Building and compiling the code on S32DS vision IDE.



**Fig-3**: Indicates flow chart of the project

For the project, download the latest Linux BSP from the NXP website, extract the files and boot into the SD card by creating the partitions where in 1st partition load the rootfs file and in 2nd partition image along with the board support packages will be loaded. There is another option to boot directly to the eMMC memory of S32V234evb by creating the partitions in the eMMC. This will make Linux OS to run on S32V234evb where many electronic devices run on the Linux which of high secure, highly stable, ease of use, customization, ease of maintenance etc.

The pre-recorded video will be sent from the computer to the S32V234evb using socket programming where the S32V234evb board will act as client and computer will act as a server. Initially the server code will be running on the computer and waiting for the connection with the client. The client code will be run of the computer, after debugging the code, .elf file will be generated and that .elf file will be dumped on to the SD card through remote debugging. Using the putty terminal, the USB port that is used and speed of data transfer will be set to the 115200. The boards IP address is received at the computer when the putty terminal is executed, which ensures the S32V234evb board got connected to the computer. And the socket program will be executed and tested using S32DS vision IDE and S32V234evb board.The connection between S32V234evb and computer is established. Initially hardware architecture of the S32V234evb is explored and connection is built.

For remote debugging and flashing the code on to the S32V234evb, LAN cable is used where the board is connected with the LAN cable and the computer will be connected to the Wi-Fi. USB cable is connected to the S32V234evb and to one of the USB port of computer, to connect the Linux BSP to the terminal program, to give the

commands and obtain the IP address. Power supply of 12volt is given to the S32V234evb via power supply cable. After connecting all the cables, building and debugging of the code is carried out.
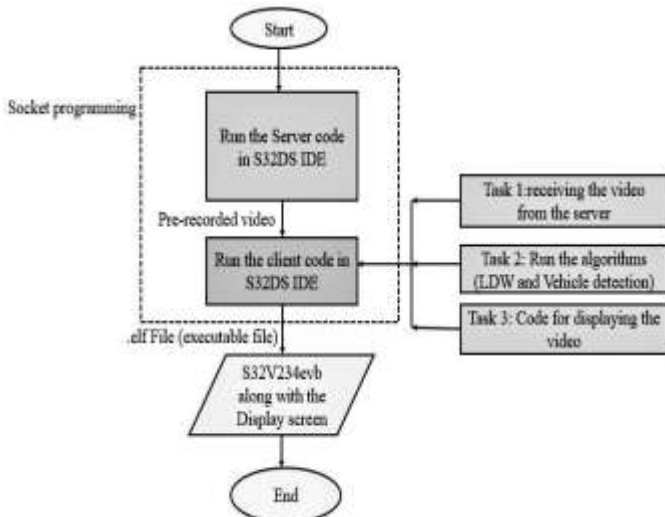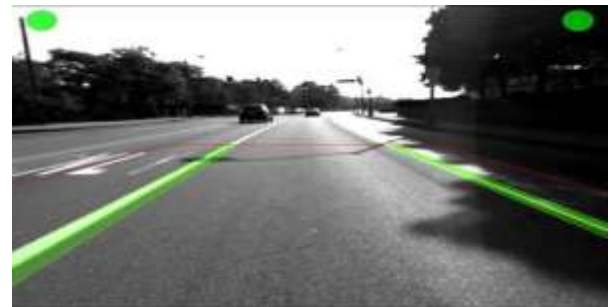
## 4 Expected Output



**Fig- 4**: Indicates the Lane detection

In the above figure indicates the lane detection where the green lines indicate the lanes has been detected. If the vehicle departs the lane, then that lane indicates the red in color which is a sign of warning to the driver.



**Fig-5**: Indicates the vehicle detection

The above figure indicates the vehicle detection where the bounding boxes are used to present the vehicle detection. This vehicle detection is used for many applications in ADAS, where it can be used for forward collision warning, parking assist, etc.

## 5 Results



**Fig-6**:Indicates the building of code and genertion of .elf file

The above screenshot indicates the code running on S32DS and after running the code, build is done, .elf file is generated. The file that is generated is dumped on to the S32V234evb.



**Fig-7**: Indicates debugging of the code

The above screenshot indicates the debugging of the code in S32DS vision IDE and connecting the computer to the S32V234evb.

## 6. Conclusions

In this project, implementation of Lane departure warning and vehicle detection is done using S32V234evb. The algorithm is executed on S32DS vision IDE. Initially the pre-recorded video will be sent from the server(Computer) to the client(S32V234evb), the pre-recorded video will be passed through the algorithm, the lanes, vehicles will be detected and in the pre-recorded video, all the scenarios will be considered. So lane will be detected and warned when the vehicle crosses the lane, that warning will be of visual were the lane that departed will be displayed as red in color.

During the implementation process, .elf file will be dumped on to the board and executed. Uploading of the project created .elf file onto the board was successful and screenshot of it has been shown in results topic.  Due unavailability of display drivers of S32V23evb from NXP, the display of the output i.e lane detection and vehicle detection on screen was not presented. These drivers should be added by the NXP to illustrate the LDW or any other algorithms on the S32V234 evb board.

## 7 Future Scope

This project can be improvised by getting the display drivers, installing the display drivers from NXP to demonstrate the code on S32V234evb. The algorithm can be enhanced by merging the LDW and vehicle detection algorithm, where the system will be detecting the lanes and warning the driver if the lane change occurs similarly the vehicles will be detecting if the ahead vehicle changes the lane, then that situation should be warned to the driver through the visual warning or audio warning. Algorithm should be enhanced by making it work in bad weather conditions, curve roads, bad light weather conditions.

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