Smart Peril Avoidance and Advanced Driving Assistance System

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***Abstract*—The following paper is all about solving the problems faced by the driver while driving and thus providing them with advanced driving assistance. The solution provided by our designed project will be beneficial in saving the lives of people around the globe. Thus, automation is the key to solve day to day issues and reducing the complexities. The paper will be providing the solution to the major problems faced by the driver on road and thus, preventing accidents. The paper provides the information regarding the entire design of the automated system and its role in saving the lives and its broader aspects. TIDEP-0094 or IWR1642BOOST evaluation board embedded with an IWR1642 chip and XDS110 MCU is used to perform the required operation using mmWave Technology. The mmWave sensor (IWR1642) is used to detect any obstacle near it. It sends the data to the MCU XDS110 where it is processed to perform the different operations.**

Keywords—Troxler's fading, Headlight Peril avoidance, accident, mmWave, TIDEP-0094 EVM.

I. INTRODUCTION

The 21st century has been a game changer in the field of automation and has a great future ahead. Each developmental activity should be solving a specific issue faced by the society or a specific group. Hence the development process is very much dependent on the way a problem is being addressed and the core innovation in solving the issue. The advancement of technology has led us to the phase where we are pretty safe while on the vehicle as compared to the previous scenario. Automobiles were not safe in the early era and very few safety measures were taken by the automotive industry. With the advancement in the technology, automation has played a vital role in developing life-saving systems like ABS and automated airbag deploy system. But, still, challenges are faced by these technologies because this is not the complete solution and comfort what a rider or driver expects. There isn't a package which provides the complete solution and at the same time analyzes the accidental certainties and that too at a nominal economic rate. Thus, the design of the project provided by this paper takes into account in solving some of the major problems faced by the drivers as well as providing it at a low cost.

II. CHALLENGES

Deaths due to accidents have been a major issue in the roadways which has caused huge loss. The analysis of on-road death shows that deaths on road have caused about $ 8 Billion economy loss in India itself. One of the most potential factors is- TROXLER'S FADING i.e., due to sudden fall of the high beam coming from the Headlights of opposite incoming cars, a temporary blindness is caused in the driver's eyes due to which the driver is unable to see anything in front of him and thus, accident is caused. Still, the problems remain and have not yet been solved. Problems and difficulty still persist in the mentioned field. To overcome the life taking certainties, we have proposed a system which will not only help in preventing accidents but also will provide the integrated system at an economical cost.

A. Existing System

In the existing system, there have been a no of automated systems helping the drivers while driving like ABS, headlight splitting system, and a no of other systems but they are not still very much effective in helping the drivers and moreover, the cost of the existing systems are also not much economical.

III. PROPOSED SYSTEM

The design of the project has the following features integrated into it.

A. Automatic Headlight Dipping Technology

Automatic Headlight Dipping Technology - to automatically dip the headlights of the opposite incoming car if the brightness of the headlight is above the threshold level. It will save the driver from Troxler's Fading and thus effectively prevent accidents. In the designed the communication will be established in between the two cars only if they are at a specific distance from each other and as soon as, the cars are not in range communication will not and the headlights will go their previous state. mm-wave Technology is used to design the entire system and for this mm-Wave sensor, chips are used along with other components. The biggest advantage of this robot is that it can work in any environmental conditions like rain, dust, smoke, fog, or frost and in complete darkness or in the glare of direct sunlight These sensors are also small and lightweight when compared to other types of LIDAR based sensors.

- Millimetre wave (also mmWave) [1] is the band of spectrum between 30 gigahertz (GHz) and 300 GHz.
- IWR1642 [2] is a very large scale integrated single-chip mmWave sensor which is based on FMCW radar technology. It has the ability to operate in the 76- to-81 GHz band with continuous chirp up to 4 GHz. This device is built with TI's

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low-power 45-nm RF CMOS process, which enables it to possess unparalleled extent of integration into an extremely tiny form factor as shown in Fig.1. IWR1642 is the perfect provision for industrial applications such as construction automation, industrial automation, drones, self-driving vehicles, traffic supervision, and surveillance. This advanced module can work in any weather condition and poor visibility conditions making it extremely robust to use in practical and real-life implementation.

Fig.1. IWR1642

- TIDEP-0094 is a development platform which is used to detect the object using IWR1642 evaluation module (EVM). This will help to determine the position (azimuthal plane) along with the velocity of the objects at a distance of up to 84 m as shown in Fig.3.
  - Two 20-pin Launchpad connectors that leverage the ecosystem of the TI Launchpad
  - XDS110 based JTAG emulation with a serial port for onboard QSPI flash programming
  - Back-channel UART through USB-to-PC for logging purposes
  - Onboard antenna
  - 60-pin, high-density (HD) connector for raw analogue-to-digital converter (ADC) data over LVDS
  - Trace-data capability
  - One button and two LED's for basic user interface
  - 5-V power jack to power the board
  - The operational angle of the radar is orthogonal to the PCB. To enable easy measurements on the sensing objects on the horizontal plane, the PCB can be mounted vertically as shown in Fig.2. The L-brackets provided with the IWR1642 EVM kit, along with the screws and nuts help in the vertical mounting of the EVM as shown in Fig.3.
  - The mmWave sensors are used to detect the cars coming from the opposite direction by means of it's highly precise mm waves that operate at high frequency and with the help of the PCB antenna integrated within the TIDEP 0094 EVM and the working of these sensors and EVM are simultaneously accompanied by the Light Dependent Resistors (LDRs) and the Relay Modules.

Fig.1. TIDEP-0094

Table.1. General features of IWR1642

FUNCTION	IWR-1642
No of Receivers	4
No of Transmitters	2
On-Chip Memory	1.5
Max I/F (Intermediate Frequency) (MHz)	5
Max Real Sampling Rate (msps)	12.5
Max Complex Sampling Rate (msps)	6.25

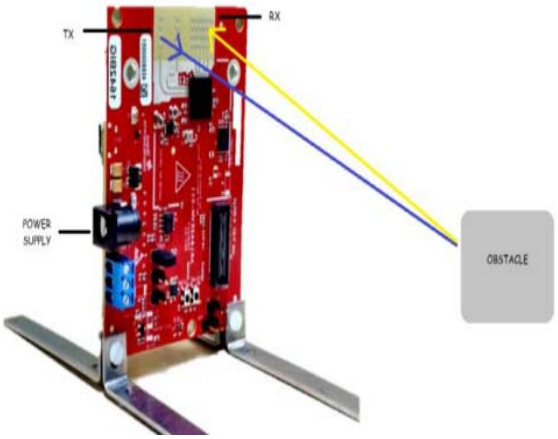

Fig.3. Schematic Diagram.

- Light Dependent Resistor (LDR)[5][9]. The following diagram below shows the basic design of a Light Dependent Resistor (LDR) and the graphical representation showing the relationship between the Intensity of light falling on the LDR and the change in resistance occurring with it.

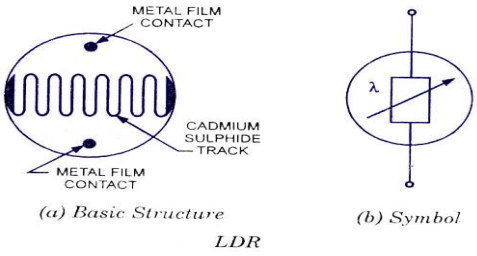

Fig.4. Design of LDR

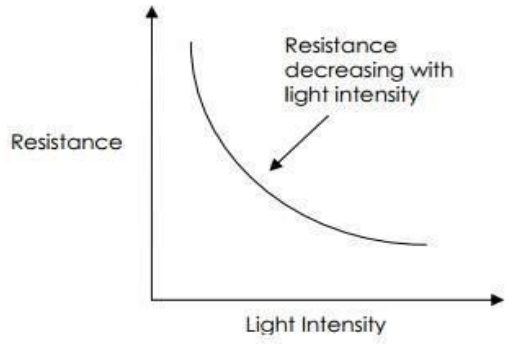

Fig.5. Characteristics of LDR

B. Core Technical Innovation Of The Paper

The design of our project includes an automatic headlight dipping technology. In this system, there are mainly three major parts in which the entire action of headlight-dipping can be categorized into mainly these:

- **Communication Between The Opposite Upcoming Cars:** In this system, there are TIDEP-0094 EVM installed in the cars. This EVM consists of IWR -1642 mmWave chips along with PCB Antennas which helps in the communication to get established in between the cars. When the two opposite incoming cars are in the 80- metre range, then communication is established with precise angular precision and with great accuracy even in drastic environmental conditions and in the case of heavy traffic conditions too.
- **Headlight Brightness Threshold Measurement And Comparison:** As soon as the communication gets established in between the two opposite incoming cars, the brightness of the headlight coming from the opposite car is measured by means of the Light Dependent Resistor (LDR) by means of the value of resistance got by the intensity of light falling on the LDR. As soon as the threshold level of the brightness of headlight is crossed,the LDR automatically triggers the Relay Module for the switching action the Dipping of the headlights of the cars.
- **Automatic Triggering Of The Headlights Via The Relay Module [10][11]:** After the threshold limit of the brightness of the headlight of the car is crossed, the LDR triggers the relay module to automatically dip off the headlights, and after the communication between the two cars gets over, again the headlights return to their previous states. Also, there is a manual switch which enables the driver to control the dipping of the headlights as per as their will. Thus, in this way, the Automatic Dipping of the Headlights is done.
- **Algorithmic Representation And Design Block Diagram Design:** Here is the block diagram of our designed system and also the algorithmic representation of the working of the above system:
  - The car starts mm-Wave Transmitter transmits the mm-waves.
  - The mm-Wave receiver receives the mm-waves.
  - The PCB Antenna on the TIDEP-0094 EVM helps in directional establishment of communication.
  - Next, simultaneously at the same time, the amount of light falling from the headlight on the LDR is measured.
  - Then, as the brightness of light crosses the threshold limit, the LDR by means of the MCU drives the relay module to automatically dip off the headlights.
  - Once, there is no more communication in between the two cars, the headlights return to their previous state.

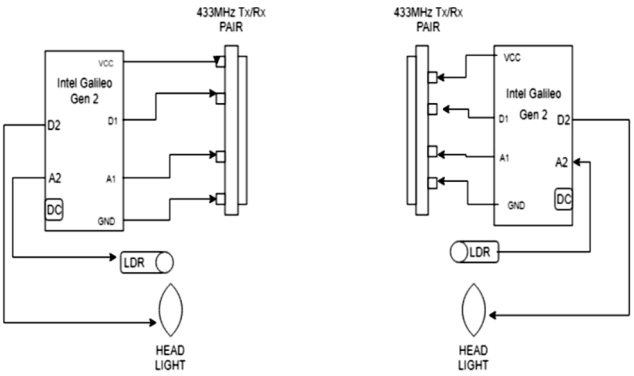

Fig.6(a). Block Diagram Of The System

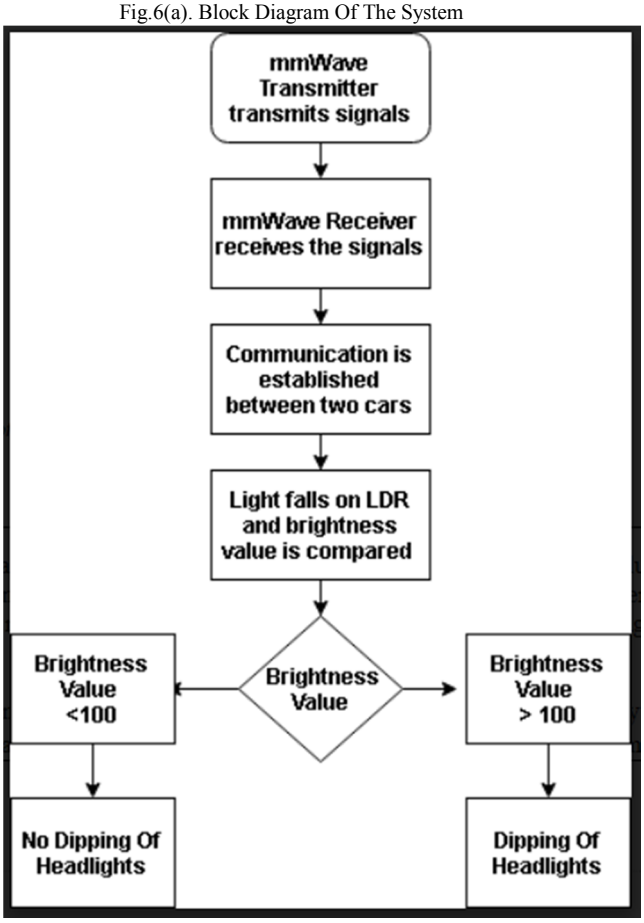

Fig.6(b). Block Diagram Of The System

- **Result And Implementation Of The Designed System:** EVM projects a point cloud of the detected object's position, range, velocity and angle to a computer running Robot Operating

System or ROS [4]. ROS uses this point cloud data to detect and avoid obstacles in the robot's path by creating a new path for the robot according to the following algorithm as shown in Figs.10 and 11. The cloud point data represents the opposite incoming cars on the roads. It is highly precise in nature and works with utmost accuracy even in drastic traffic and environmental conditions like dust , rain , direct glare of sunlight etc. The above figure shows the test results for a car at 80 meter range.

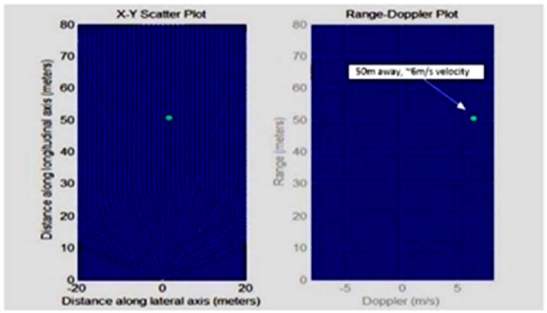

Fig.7. Small Test Car At ~80m Distance.

C. *Future Scope And Advancement Of The Project*

Presently , we are working on the future advancement of the developed system using the mmWave Technology i.e., Auto-Braking System, Auto - Lane Changing System and more. The picture showing our present work on the advancement of the project is given below:

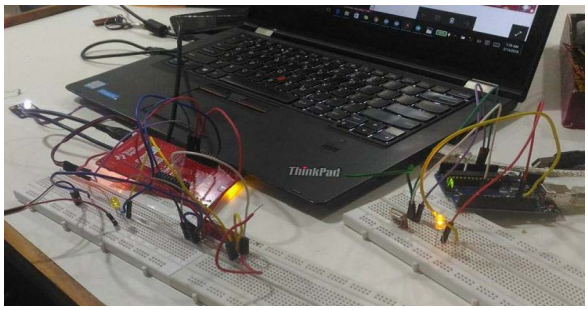

Fig.8(a) Automatic Accident Detection System Via Mmwave Technology & Auto-braking System

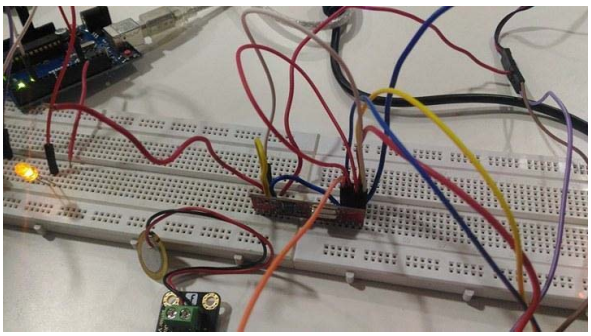

Fig.8(b). Automatic Accident Detection System Via Mmwave Technology & Auto-braking System

[3] TIDEP-0094 EVM: 80m-Range Object Detection Reference Design With Integrated Single-Chip mmWave Sensor. http://www.ti.com/tool/TIDEP-0094

D. *Implementation:*

This technology of precise car detection and further dipping of the headlights using mmWave can be used in various like fields like making of autonomous robots like swarm drones and swarm robots and in various field like in military to develop autonomous stealth bots and also in medical application. Moreover, in the field of Advanced Automotive Electronics and technology, they are useful for Auto-Braking System, Auto-Lane changing system etc on which we are presently working. They can also be used to make an autonomous parking system for a vehicle and autonomous delivery robots. The flowchart for the complete operation is as follows: mmWave is a very robust sensing technology for detection of objects and determination of the range, velocity and angle of the objects. It is a contactless-technology which can operate in the spectrum 30 GHz and 300GHz. Operating in this spectrum makes mmWave sensors much more valuable for the following reasons:

- It is highly Directional: It can produce a compact beam with a 1º angular accuracy
- Light-like: It can be focused and directed using standard optical procedures
- Large bandwidths: It has the capability to distinguish between two nearby objects owing to its large absolute bandwidth

IV. CONCLUSION

we have actually designed the system in order to provide an advancement in the field of Automotive Electronics and thus, reduce the number of accidents occurring every day and so saving a lot of lives. In fact, we have designed the system mainly with the help of mmWave Technology. This technology is highly precise and accurate in determining the position of the cars on the roads and depending upon that further communication is established and thus, dipping of the Headlights is done based upon the threshold condition. The robustness of the mmWave sensors i.e. IWR1642 allows it to work in poor visibility conditions like fog, dust, smoke, humidity, ambient lighting.

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