Advanced Driver Assistance System (ADAS) to Avoid Accidents

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Abstract — The abstract of a system leveraging Advanced Driver Assistance Systems (ADAS) to prevent accidents at T-junctions: In response to the pressing need for enhanced road safety, particularly at T-junctions where accidents often occur, this abstract proposes the implementation of a sophisticated ADAS solution. T-junctions pose significant challenges to drivers due to limited visibility and the potential for conflicting traffic movements, making them prime locations for accidents. Leveraging the capabilities of ADAS, this proposed system aims to mitigate these risks by providing drivers with real-time assistance and augmenting their situational awareness. The system integrates a combination of sensors, and advanced algorithms to detect approaching vehicles, pedestrians, and obstacles, especially from blind spots. Through intelligent data processing and predictive analytics, the system can anticipate potential collision scenarios and alert the driver promptly. Furthermore, the ADAS system can autonomously intervene when necessary, applying corrective actions such as automatic emergency braking or steering assistance to avoid accidents. By enhancing driver perception and response capabilities, this ADAS solution endeavours to significantly reduce the frequency and severity of accidents at T-junctions, ultimately contributing to improved road safety and saving lives.

Keywords: Advanced Driver Assistance System (ADAS), Accidents

I. INTRODUCTION

Advanced Driver Assistance Systems (ADAS) represent a significant advancement in automotive technology, offering innovative solutions to improve road safety and mitigate accidents, particularly at complex intersections like T-junctions. This introduction delves into the project's methodology utilizing ADAS features, specifically incorporating Arduino-based ultrasonic sensors, RF modules, and vehicle units equipped with motor drivers and RF receivers, to enhance safety at T-junctions.

At the heart of this project lies the integration of cutting-edge technology into vehicles to address the challenges posed by T-junctions, notorious for their inherent safety risks due to limited visibility and complex traffic interactions. By leveraging ADAS components such as Arduino-based ultrasonic sensors, RF modules, and vehicle units comprising motor drivers and RF receivers, the project aims to revolutionize collision prevention and safety measures at these critical intersections.

The utilization of Arduino-based ultrasonic sensors enables real-time detection of obstacles and vehicles approaching the T-junction, providing crucial data for proactive decision-making. Coupled with RF modules, seamless communication is established between vehicles, allowing for synchronized actions to prevent collisions. Meanwhile, the vehicle unit's integration with motor drivers and RF receivers empowers swift and coordinated responses to potential hazards, ensuring timely intervention to avert accidents.

Through the amalgamation of these advanced technologies, the project endeavors to not only prevent accidents but also redefine the landscape of intersection safety, setting a precedent for future innovations in ADAS applications. As vehicles equipped with these sophisticated systems navigate T-junctions with enhanced awareness and responsiveness, the vision of safer roads and reduced accidents becomes increasingly attainable, heralding a new era of road safety propelled by technological innovation.

II. BLOCK DIAGRAM

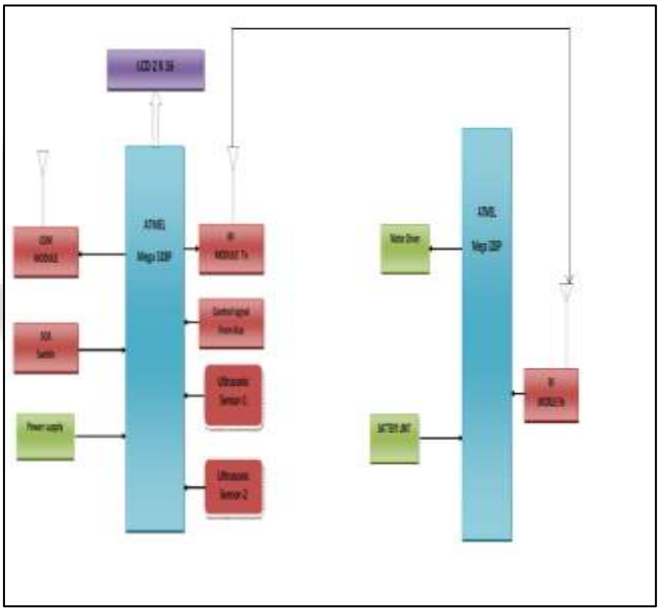

Fig. 1: Block Diagram of the System

III. LITERATURE SURVEY

A. Chaudhari Priyanka Ramnath, Advanced Driver Assistance System, International Journal of Advanced Research in Electronics and Communication Engineering, 2015, Volume 4, Issue 10

Chaudhari Priyanka Ramnath proposed several methods to provide safety while driving like collision avoidance using IR sensors, fuel detection systems, lane change assistance, and adaptive light control system. The primary downside is that the IR sensors used to determine the presence of other vehicles, pedestrians, and some other objects to avoid crashes and accidents. In case of reliability ultrasonic sensors are better than IR sensors and the maximum range of an ultrasonic sensor is about 20 meters while for the IR sensor it is only between 1-5 meters and also depends on the type of IR sensor which is used the operating range will also vary.

B. Nayana H.C, Basavaraj Neelgar, Rahul Hiware, Object Detection and Classification for Vehicle Advanced Driver Assistance System, International Journal of Engineering Science and Computing, 2017, Volume 7, Issue 6.

Nayana.H.C, Basavaraj Neelgar, Ragul Hiware proposed methods to detect objects like vehicles and pedestrians by using the Pi camera module which is useful for collision avoidance among vehicles and with some other objects. But in smoky and dust conditions the Pi camera will not be suitable for capturing images due to poor visibility it will result in blur images which is not sufficient for object detection while driving and makes the driving tougher.

C. Ashok Kumar, Kavitha.V, Jegan R.R, Satish.S, A Beacon Automatic Vehicle Speed Control System for Restricted Zone, International Journal of Research, October 2018, Volume 7, 2236-6124.

Ashok Kumar.R, Kavitha.V, Jegan.R, Satish.S proposed speed limit recognition using Beacon technology. This beacon work along with Bluetooth enabled in mobile phones to provide notification of speed limits whenever the vehicle comes into the region where beacon tags are placed. The only disadvantage is that the Beacons can be used along with smart phones with Bluetooth enabled if there is no connection or due to poor connection with mobile phones there may be a lack in the transformation of information to the drivers. And the other disadvantage is the cost, it is not cost-effective and battery friendly. Having a mobile with an enabled Bluetooth connection isn't battery friendly and very few customers will comply to keep their Bluetooth activated to attach with beacons.

IV. PROPOSED METHODOLOGY

The methodology for the project involves the implementation of a robust system to prevent accidents at T-junctions by utilizing ultrasonic sensors positioned along the sides of the roads adjacent to the junction. This approach eliminates the need to directly integrate sensors into the vehicles, allowing for a more flexible and scalable solution. The project begins with the setup of two vehicles equipped with motor controllers and RF module transceivers, designated as the transmitting and receiving units respectively. The transmitting unit continually broadcasts its position and status to the receiving unit via RF communication, facilitating real-time data exchange between the vehicles.

Meanwhile, ultrasonic sensors are strategically installed along the sides of the roads leading to the T-junction, covering the areas where vehicles approach and potentially intersect. These sensors continuously monitor the proximityof vehicles as they approach the junction, providing valuable data for collision detection and prevention. Arduino boards are employed to process the sensor data, implementing algorithms to identify potential obstacles and predict imminent intersection encounters based on predefined thresholds.

Upon detection of an obstacle within the vicinity of the T-junction, the Arduino board of the transmitting unit initiates a communication sequence with the receiving unit via the RF module. This communication triggers a synchronized response from both vehicles, prompting them to execute coordinated stopping maneuvers to prevent a collision. The motor controllers of the vehicles receive commands from the Arduino boards to decelerate and eventually come to a complete stop, ensuring safe navigation through the junction.

Thorough testing and optimization are conducted to validate the functionality and reliability of the system under various conditions, including different vehicle speeds, traffic densities, and environmental factors. Real-world deployment allows for the evaluation of the system's performance in practical driving scenarios, providing valuable insights for further refinement and enhancement.

Overall, the methodology encompasses the integration of hardware components, communication protocols, sensor data processing, and decision-making algorithms to create a comprehensive ADAS system tailored specifically for preventing accidents at T-junctions. By leveraging external ultrasonic sensors and wireless communication technology, the project aims to deliver a scalable and effective solution for enhancing road safety at critical intersections.

VEHICLE UNIT

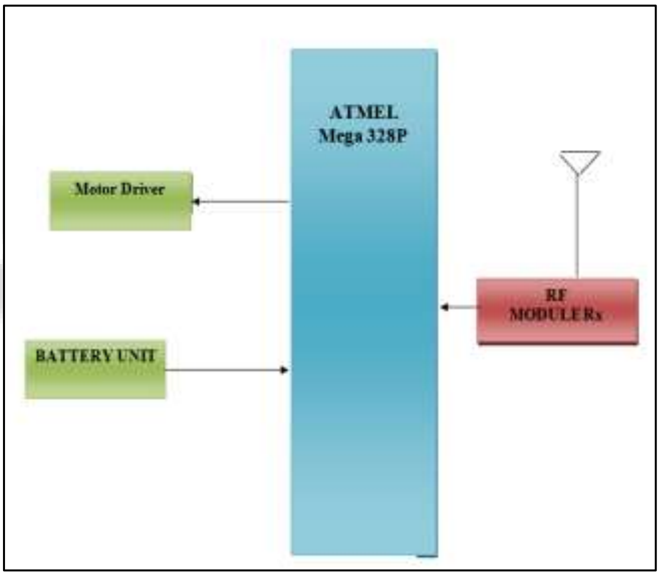

Fig. 2: Vehicle unit

V. HARDWARE AND SOFTWARE REQUIREMENT

A. Hardware Description

1) Arduino UNO:

The Arduino Uno serves as the cornerstone of our hardware setup, featuring the ATmega328 microcontroller chip. With its array of 14 digital input/output pins, six of which are PWM-enabled, and six analog inputs, the Uno offers versatile functionality suitable for a wide range of projects. Its integration of a 16 MHz ceramic resonator, USB connectivity, power jack, ICSP header, and reset button provides a robust foundation for microcontroller development. Notably, the Uno distinguishes itself from prior iterations by employing the Atmega16U2 (or Atmega8U2 for versions up to R2) as a USB to-serial converter, bypassing the need for the FTDI USB-to-serial driver chip. In its latest

Revision 3, the Uno introduces several enhancements, including the addition of SDA and SCL pins adjacent to the AREF pin, as well as two new pins in proximity to the RESET pin. Additionally, Revision 3 incorporates a resistor that pulls the 8U2 HWB line to ground, facilitating smoother transitions into DFU mode without reliance on external tools.

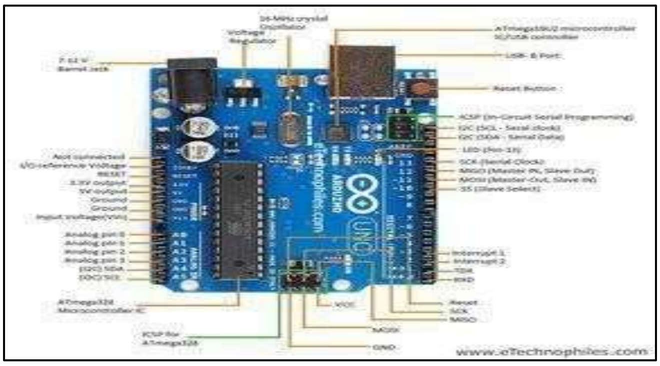

Fig. 3: Arduino Uno Pin Description

2) HC-SR04 Ultrasonic Sensor:

Fig. 4: HC-SR04 ULTRASONIC SENSOR

The HC-SR04 ultrasonic sensor emerges as a cornerstone element within our project, embodying a crucial role in the detection of obstacles and precise distance measurement. Its operational principle revolves around the emission of ultrasonic waves, followed by the calculation of the time taken for these waves to rebound upon encountering an obstacle. This process facilitates the accurate determination of the obstacle's distance from the sensor. Characterized by its compact design and lightweight construction, the HC-SR04 sensor seamlessly integrates into our system framework without imposing significant space or weight constraints. Noteworthy for its extensive detection range and remarkable precision, this sensor ensures consistent performance across diverse environmental conditions and operational scenarios. By interfacing the HC-SR04 sensor with the Arduino Uno microcontroller board, we establish a seamless integration pathway, facilitating real-time obstacle detection and proactive avoidance strategies at T-junctions. Leveraging the robust capabilities of the HC-SR04 sensor, our project endeavors to elevate road safety standards by preemptively addressing potential collision risks and fostering safer driving experiences.

*3) LCD DISPLAY 16*2:*

Fig. 5: 16*2 LCD DISPLAY

To facilitate the concurrent display of information on two LCD screens, we employ the Arduino Uno microcontroller in tandem with a pair of LCD displays. The setup entails establishing individual connections between each LCD display and the Arduino Uno, ensuring proper alignment of data pins, power inputs, and ground connections. By configuring the LCD displays in parallel with the Arduino, we establish a robust communication framework for seamless data transmission.

Subsequently, we develop Arduino code tailored to retrieve and format the desired information for display across both LCD screens. This information may encompass sensor readings, system status updates, or other pertinent data points, meticulously organized to meet the LCD displays' specifications.

Upon compiling and uploading the code to the Arduino Uno, the microcontroller initiates the execution of instructions, procuring the specified information and transmitting it concurrently to both LCD screens. As responsive output devices, the LCD displays receive the data signals from the Arduino and promptly render the information in a legible and coherent manner.

This configuration effectively harnesses the computational prowess of the Arduino Uno microcontroller to drive two LCD displays simultaneously, facilitating the seamless dissemination of information across dual visual interfaces. Such integration enhances accessibility, visibility, and user engagement, fostering efficient system monitoring, comprehensive data visualization, and an enriched user experience.

4) Regulated power supply:

The power supplies are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A RPS (Regulated Power Supply) is the Power Supply with Rectification, Filtering and Regulation being done on the AC mains to get a Regulated power supply for Microcontroller and for the other devices being interfaced to it. A power supply can by broken down into a series of blocks, each of which performs a particular function. A dc power supply which maintains the output voltage constant irrespective of Ac mains fluctuations or load variations is known as “Regulated D.C Power Supply”

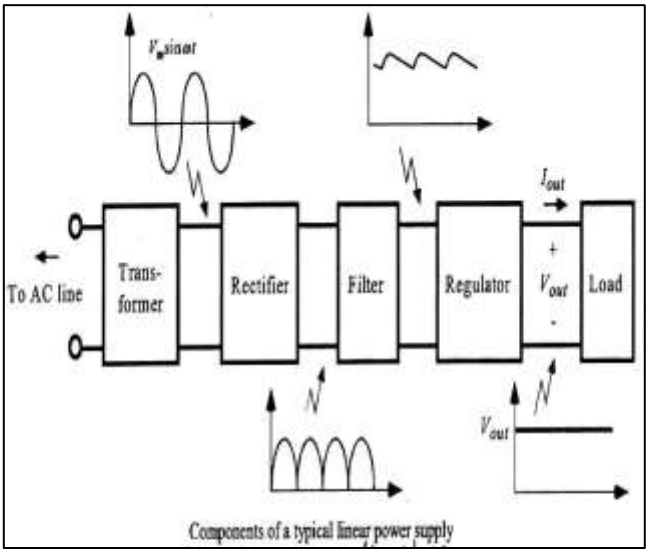

Fig. 6: Regulated power supply

5) Transformer:

A step-down transformer serves as an indispensable component in electrical systems, facilitating the conversion of high-voltage alternating current (AC) to lower voltages suitable for specific applications. In the case of converting 220 volts to 12 volts, the transformer undergoes a reduction in voltage while maintaining the frequency of the AC waveform. This process involves a primary winding, typically designed to handle the higher voltage, and a secondary winding engineered to produce the desired lower voltage output.

The construction of the step-down transformer encompasses insulated wire windings wound around a laminated iron core. The primary winding, connected to the 220-volt power source, induces a magnetic flux within the core when energized by the alternating current. This flux, in turn, induces a voltage across the secondary winding, proportionate to the turns ratio between the primary and secondary windings.

Through meticulous design and engineering, the turns ratio is precisely calibrated to achieve the desired voltage reduction from 220 volts to 12 volts. The secondary winding's output is then made available for utilization in various electronic devices, appliances, or circuits requiring a lower voltage supply.

Additionally, the transformer's design factors in considerations such as efficiency, insulation, and thermal management to ensure optimal performance and safety during operation. By providing a reliable and stable 12-volt output, the step-down transformer plays a crucial role in powering a myriad of electronic equipment and systems, contributing to the seamless operation of diverse electrical applications.

Fig. 7: Transformer

6) GSM – Architecture:

A GSM module is a critical component in modern communication systems, enabling devices to establish wireless connections to cellular networks. These modules are compact electronic devices equipped with specialized circuitry and antennas designed to transmit and receive signals within the GSM frequency bands. Compliant with GSM standards, they ensure compatibility with global mobile networks, offering seamless communication across various geographical regions.

GSM modules facilitate a range of communication services, including voice calls, data transmission, and messaging. By interfacing with a Subscriber Identity Module (SIM) card, these modules gain access to the cellular network, enabling users to initiate and receive voice calls using connected audio peripherals such as microphones and speakers. This feature is essential for applications requiring real-time voice communication, such as security systems and remote monitoring solutions.

In addition to voice calls, GSM modules support data transmission, enabling devices to exchange information with remote servers or other devices over the cellular network. This capability is invaluable for applications like telemetry, remote control, and machine-to-machine (M2M) communication, where real-time data exchange is crucial for operational efficiency.

Moreover, GSM modules often feature Short Message Service (SMS) functionality, allowing devices to send and receive text messages over the cellular network. This feature facilitates communication in situations where voice calls may not be feasible or practical, such as sending remote alerts or notifications.

Overall, GSM modules play a pivotal role in enabling wireless communication across a broad spectrum of applications, from consumer electronics to industrial automation. Their compact design, reliable performance, and versatile functionalities make them indispensable components in modern telecommunications systems, empowering devices to connect and communicate seamlessly.

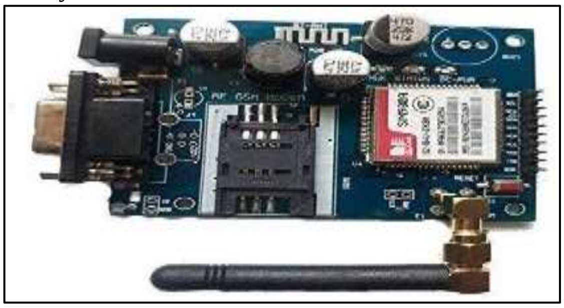

Fig. 8: GSM -Architecture

7) PIEZO BUZZER:

The piezo buzzer produces sound based on reverse of the piezoelectric effect. The generation of pressure variation or strain by the application of electric potential across a piezoelectric material is the underlying principle. These buzzers can be used alert a user of an event corresponding to a switching action, counter signal or sensor input. They are also used in alarm circuits.

Fig. 9: Piezo buzzer

8) RF MODULE

Wireless Transmitter and Receiver using ASK RF Module:

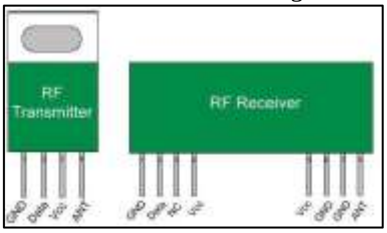

Fig. 10: RF Module

Features of RF Module:

- Receiver frequency 433MHz
- Receiver typical frequency 105Dbm
- Receiver supply current 3.5mA
- Low power consumption
- Receiver operating voltage 5v
- Transmitter frequency range 433.92MHz
- Transmitter supply voltage 3v~6v
- Transmitter output power 4v~12v

B. Software requirement

1) Arduino IDE Software

Arduino is a type of computer software and Hardware Company that offers open-source environment for user project and user community that intends and fabricates microcontroller based inventions for construction digital devices and interactive objects that can sense and manage the physical world. For programming the microcontrollers, the Arduino proposal provides an software application or IDE based on the Processing project, which includes C, C++ and Java programming software. It also support for embedded C, C++ and Java programming software. Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control the physical world. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino platform provides an integrated development environment (IDE) based on the Processing project, which includes support for C, C++ and Java programming languages.

An Arduino board consists of an Atmel 8, 16 or 32-bit AVR microcontroller with complementary components that facilitate programming and incorporation into other circuits. An important aspect of the Arduino is its standard connectors, which lets users connect the CPU board to a variety of interchangeable add-on modules known as shields . Some shields communicate with the Arduino board directly over various pins, but many shields are individually addressable via an I²C serial bus so many shields can be stacked and used in parallel. Official Arduinos have used the mega AVR series of chips, specifically the ATmega8, ATmega168.

An Arduino's microcontroller is also pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory, compared with other devices that typically need an external programmer. This makes using an Arduino more straightforward by allowing the use of an ordinary computer as the programmer. Currently, opti boot loader is the default boot loader installed on Arduino UNO. An Arduino's microcontroller is also pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory, compared with other devices that typically need an external programmer. This makes using an Arduino more straightforward by allowing the use of an ordinary computer as the programmer.

VI. RESULT AND SNAPSHOT

VII. CONCLUSION

Advance driver assistance system(ADAS) needs huge attention in India as accidents occurring at various Intersections is a serious problem. We have gathered sufficient data for accidents occurring at intersection in India out of which we have noticed that T-Junction has the highest share amongst all. Our main concern was the selection of wireless communication technology and we found RF module to be more acceptable for our system in real time environment. Our system allows a node to be deployed at speed bumps before T-Junction to communicate with Master node and display warning message on display board(which needs to be located at the center of T-Junction at a visible height).To implement this we need to add speed bumps or rumbles before 50 m of distance from Master node so that presence of vehicle can be detected easily using ultrasonic sensor and RF module attached and it can communicate with Master node too

VIII. REFERENCES

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