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# Intelligent Electric Vehicle

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*Abstract - Greenhouse gas emissions, produced by various sectors, including transportation, are significantly impairing the environment and drive climate change. Battery electric vehicles are increasingly seen as a way to alleviate these problems, but they must be charged with electricity produced through environmentally friendly methods. Electric vehicles are the best solution for green transportation due to their high efficiency and zero greenhouse gas emissions. Various electric motors have been used as the propulsion system of electric vehicles. The robust performance of the in-wheel BLDC motor drives is an important factor in the safety of electric vehicles. When anything is in the blind spot, it gets impossible to see, unless the driver turns his/her head back, which again is dangerous as the need to keep the eyes on the road ahead all the time. This is exactly why blind spots turn out to be so dangerous and become a cause of many mishaps. In this paper, the aerodynamic design of the car is carried out by considering the mechanical and electrical parameters of the vehicle. The sizing of the EV power train is carried out to fix the motor size and battery capacity. A blind spot for the driver is reduced by adopting ultrasonic and LiDAR sensors which cover 180-degree rear part of the vehicle. Highly efficient RGB LED strips have been incorporated into the vehicle to indicate the position of obstacles based on distance that generates different color modes for easy identification for the driver.*

***IndexTerms* – BLDC, Blind spot, LiDAR, Ultrasonic.**

## I. Introduction

Nowadays we are facing a lot of different crises caused by high oil prices and obsolete designs which have prompted the search for more efficient road vehicles, possibly based on environment-friendly sources located in politically stable areas. This has led to the development of electric vehicles.

Electrical vehicles are based on an electric propulsion system where no internal combustion engine is used and all the power is based on electric power as the energy source. Electric vehicles have low running costs as they have fewer moving parts for maintenance and are also very environmentally friendly as they use little or no fossil fuels.

The sleeker a vehicle is, the more easily it can combat air resistance, a force that acts against the vehicle as it moves. Taller vehicles with boxy designs struggle to cut through the air while long, low-to-the-ground sports cars do so with relative ease.

Aerodynamics addresses the force of air on the objects moving through it. Designing a car with good aerodynamics positively enhances its ability to accelerate resulting in better performance of the vehicle.

Drivers are taught to assess surrounding traffic before changing lanes by checking their rear-view and side mirrors and looking over each shoulder. However, even for those who follow this sequence of checks, the vehicle's blind spot – the area alongside and just behind the vehicle – is a constant source of danger and often the cause of serious accidents. To make changing lanes safer, blind spot detection warns of impending collisions.

The blind spot is the area of the road that cannot be seen by looking in any of the mirrors available in the vehicle. Blindspot detection is nothing but detecting those blind spots on the road that the driver cannot see and giving him a warning. Blindspot sensors are usually mounted on the side mirror and rear bumper.

## 1.1 Objective

To implement BLDC motors that are most preferred for the electric vehicle application due to their traction characteristics. All of today's hybrid vehicles use a BLDC motor. Green car manufacturers often prefer BLDC motors over the alternatives because the peak point efficiency is higher and rotor cooling is simpler. The motors can also operate at a "unity power factor," meaning the drive can operate at its maximum efficiency level.

As per several surveys conducted so far, thousands of road accidents occur due to the mishandling of vehicles due to these blind spots. What's even more unfortunate is that most of these accidents could have been avoided had the drivers been aware of avoiding blind spots and blind spot accidents. Therefore, implanting sensors and a transparent body of the vehicle reduces the overall blind spots providing clear vision to the driver.

## II. LITERATURE REVIEW

The below are reference papers considered for the detailed analysis of the project and the literature survey.

In reference to [1], the paper presents a comparative study of all components used in an electric vehicle. This paper also concludes on which drive or converter is suitable for an electric vehicle is being proposed. The absorption from this paper is the understanding of the step-by-step comparative study of all components used in electric vehicles included, including electric motors, power converters, and energy storage systems. Reviewing all components, it is found that the PM BLDC motor is the best candidate for the electric propulsion system and Lithium-ion batteries are most suitable for electric vehicles compared to all other batteries used in an electric vehicle.

In reference to [2], this project focuses on a step-by-step design procedure which is the estimation of the ratings of different components in an Electric Vehicle. The absorption is the input and output parameters for an electric vehicle system and the derivation of expressions using these parameters. This paper also gives basic insights on parts of EVs namely, BLDC motors, Controllers, Battery Management Systems, Chargers, and Lithium battery modules.

In reference to [3], the authors of the paper have proposed a block diagram for the flow of data from the LiDAR to the controller and finally to the visual device. The LiDAR has been programmed with three different thresholds that depict a safe region to change lanes, a region to change lanes with caution, and the stage where the driver is advised not to change lanes. The LiDAR detects obstacles that might be stationary or in motion and continuously alarms the driver of the same. The absorption from this paper is how a LiDAR sensor works and how it is used in blind-spot monitoring and detecting system and thereby warning the driver.

In reference to [4], after detailed observation and tests performed, it is observed that the car design is to be made in such a way that it cuts through the air with ease and channelizes the air flowing over it to the rear wings. This results in a highly reduced drag and lift force acting on the car body and thereby increasing the efficiency of the vehicle. The absorption from this paper is a detailed understanding of how the external body of a car should be designed to offer optimized aerodynamics.

## III. METHODOLOGY

The source for the electrical vehicle is obtained from the high-power battery. The single-phase AC supply is converted to DC voltage using the adapter and the output from the adapter is fed to a high-power battery. Once the battery is fully charged, the state of charge (SOC) is indicated by the battery. The battery is in turn connected to the motor controller that has a Microcontroller Unit (MCU) and inverter built in.

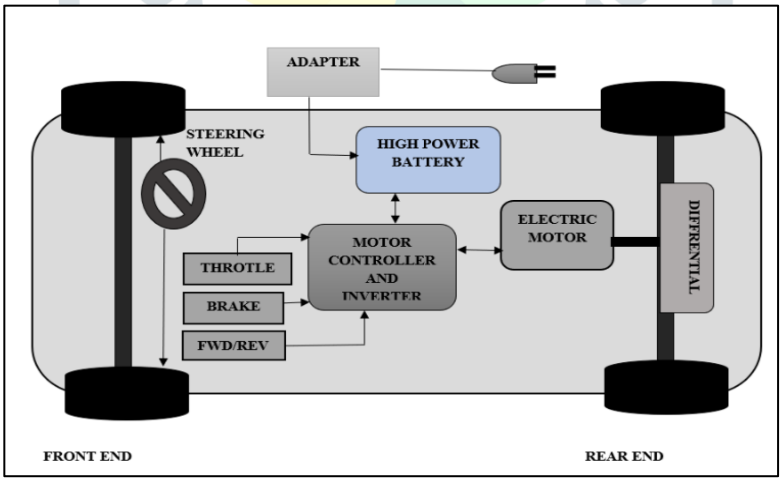


Fig - 1: Block Diagram depicting the Internal structure of the Car

The inverter circuit converts the DC voltage to AC voltage. The electrical energy from the sources is fed to the BLDC motor. The BLDC motor has 3 stator windings to which the three-phase supply is fed. The electric motor is coupled with the differential through a single-gear wheel mechanism.

When the vehicle gets started, The SOC of the battery decreases, i.e., the battery voltage starts discharging. The throttle has a hall sensor, which provides rotor position feedback to the motor controller and aids in speed control of the vehicle. But when the throttle is decelerated, the electric motor stops supplying power so that vehicle slows down. When the motor stops it immediately disengages and acts as a generator.

The captured K.E from wheels as they slow is converted to electric energy and then stored in the battery, this mechanism is known as a regenerative braking mechanism. The regenerative braking system isn't enough to stop a vehicle, so when the brake is applied both electrical and mechanical braking takes place. Variables of the study contain dependent and independent variables.

## IV. BLINDSPOT DETECTION USING SENSORS

The main aspect is blind-spot detection. We can define a blind spot as an area of road outside the driver's field of vision that cannot be seen using rear mirrors. The basic variant of blind spot detection can be implemented using ultrasonic sensors and LiDAR sensors. The function uses sensors to cover the dangerous blind spot. If another vehicle is situated in the monitored area, the driver is alerted to the potential danger using a warning sign. If the driver fails to spot or ignores this warning and activates the turn signal to change lanes, the system can also trigger an additional warning.

The key characteristics of ultrasonic and LiDAR sensors are shown in Table 1 and Table 2 respectively.

The picture depicts the use of sensors to detect the blind spot. LiDAR and ultrasonic sensors have been used in the vehicle, where 360 degrees cover is provided using ultrasonic complete surroundings and LiDAR sensors will be used in the back and sensation will be displayed to the driver using a transparent glass which will be placed in front of the steering.

LiDAR sensor range 12m.

Ultrasonic sensor 2cm - 450cm.

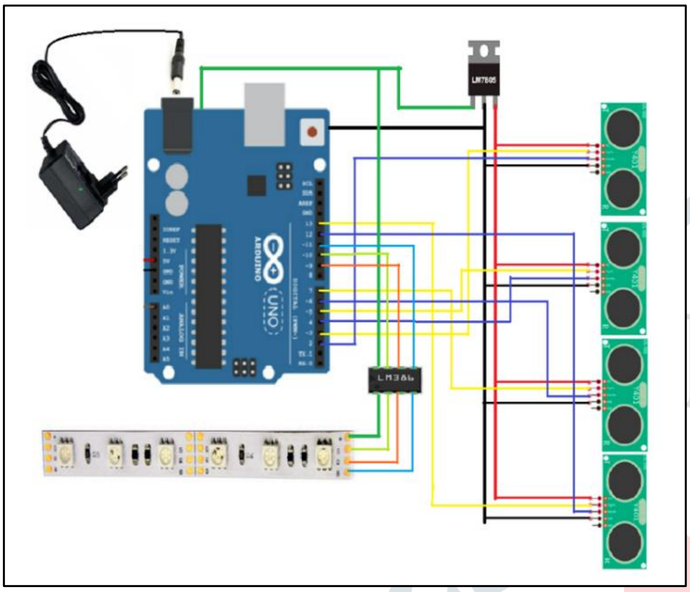

Fig - 2: Ultrasonic sensor setup for blind spot detection

Table 1 Key Characteristic Parameters of Ultrasonic Sensors

| Description | Parameter Value |
|---|---|
| Operating Range | 2cm – 450cm |
| Accuracy | 0.3cm+1% |
| Measurement angle | Less than 15° |
| Operating voltage | DC 2.4V- 5.5V |
| Operating Temperature | -20 to +70 |

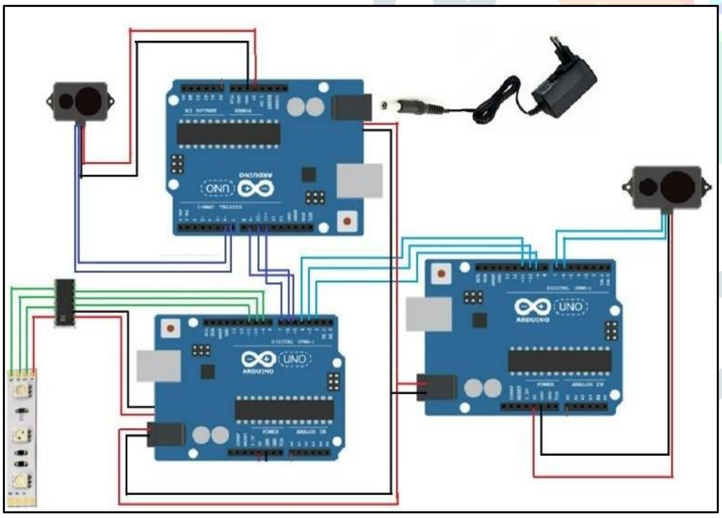

Fig - 3: LiDAR sensors setup for blind spot detection

Table 2 Key Characteristic Parameters of Lidar Sensors

| Description | Parameter Value |
|---|---|
| Operating Range | 0.1m-12m |
| Accuracy | ±5cm@ (0.1 – 6m)<br>±1%@ (6m-12m) |
| Measurement angle | 3.6° |
| Operating voltage | DC 2.4V- 5.5V |
| Operating Temperature | -20 to +60 |

## V. RESULTS AND DISCUSSION

Detection of Blind Spots is a major concern for safety issues. The blind spot of an automobile is the region of the vehicle that cannot be observed properly while looking either through the side or rear mirror view. To meet the above requirements, this paper describes detecting blind spots by using ultrasonic sensors and hence help in a smooth driving experience. In this project, the aerodynamic design of the car is carried out by considering the mechanical and electrical parameters of the vehicle. The sizing of the EV power train is carried out to fix the motor size and battery capacity. A blind spot for the driver is reduced by adopting ultrasonic and LiDAR sensors which cover the 180-degree rear part of the vehicle. Highly efficient RGB LED strips have been incorporated into the vehicle to indicate the position of obstacles based on the distance that generates different color modes for easy identification for the driver.

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