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# BIASAV (BRAIN INTERFACED AUTONOMOUS & SEMI-AUTONOMOUS VEHICLE)

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## ABSTRACT

*In this proposal we are using brain interface towards computer to control a vehicle BIASAV (Brain Interfaced Autonomous & Semi-Autonomous Vehicle). The objective of this proposed work is to reduce accidents on roads and also to provide car facilities to Disabled person. This car uses high quality electroencephalographic electrodes so probability of error is very less. This proposed car has two driving operations First Mode Autonomous: - in this mode of proposed model the persons with disabilities can input with help neuro signal as a location input for the proposed positioning system whereas in Second Mode Semi-Autonomous: -The real time data is taken as a neuro signals and directly provided to the vehicle's computer. So the proposed car will move reliant on the signals from brain and decreasing chances of accidents.*

***Keywords: Autonomous Car, Semi-Autonomous Car, Advanced Traffic Light Detector(ATLD), Advanced Global Positioning System (AGPS), Acceleration And Deceleration Indicator (ADI).***

## I. INTRODUCTION

BCI (Brain Computer Interface) is a technique in which non-muscular communication channel for transmission of signals from human brain to outside world. Brain Computer Interface processes brain's decision control signals by analyzing bioelectrical activity of human brain [2]. Brain Computer Interface operation based on many paradigms of EEG signal like motor imagination, evoked potentials. Among evoked potential SSVEP (Steady State Visually Evoked potentials) which are associated with visual stimuli frequencies observed by the user.

The basic features of autonomous car are ability of, orienting and planning ways, locating itself using Light Amplification by Stimulated Emission of Radiation(LASER) Radio Detection and Ranging (RADAR), Global Positioning System (GPS). To identify path, obstacles Advanced Control System (ACS) is used to interrupt this information. Commands in the form of neural signals are sent out from the brain when the person walks. Every body part need to be responsive on these commands. The human body is in tactile, visual and audio contact with surrounding so feedback is delivered constantly to human brain to inform about next step to be taken. A closed loop system is developed using actuators and sensors to work together. The benefits of these control systems have recognized widely, but applications to human physiological systems not proved popular. Many products offer help to disabled persons but with complex operations, some disabled persons are not able to perform these complex operations. If sensors are used to help in detecting intramuscular changes and circulatory problems are combined with actuators to help resolve problems, then this system can be improved.

Some studies evaluated traffic flow and human-factor aspects the car following with different Adapted Cruise control in various driving conditions [3][4][5][6][7]. ACC somehow enhances safety on roads by guiding driver to maintain constant speed and driver visual glance, drivers must have awareness towards its limitations and intervene if adaptive cruise control does not work properly at some sharp points [8]. Cooperative ACC is a next generation of ACC addressing the stability limits of simple ACC systems [9] [10]. To communicate vehicle to vehicle CACC systems communicate their kinematic state using high bandwidth. Inter-vehicle distance error decreases with CACC systems this guarantee stability on the roads. If 60% of cars equipped with CACC technology the accidents on roads will decreases [5] [10]. Penetration rates would be low in the introductory phase of cooperative-driving. A system that assist drivers of non-equipped cars by displaying combined acceleration information on the rear window of car equipped with CACC. Traffic Light Detection (TLD) and Advanced Driver Assistant system (ADAS) is used to decrease the no. of accidents by warning about Traffic Light [11].

This paper is organized as following: - in section II Background and Related works are provided. Sec III provides Methodology. Sec IV provides Results and Discussions. Sec V Conclusion. Sec VI References.

## II. RELATED WORK

In most of the previous works, in order to provide better experience and easy drive only Autonomous Drive is in use which performs its functions by using following systems: -

Circular Hough transform is used to reduce effect from changing lighting condition and recognizing Traffic Lights, Estimates optimal distance from car to traffic light detection while using same color background condition for traffic light detection [11][13]. In YCbCr color model the Cb and Cr channels are used, this method is tested only in day light [14]. For TLD CIELab and HSV color models can be used. For solving blooming effect CIELab model is used to detect Traffic Light [15], HSV is also used for this purpose [16] with CAMSHIFT (camera shift) to track the location of TL's [17] describes a technique for TLD that does not rely on color information with a Support Vector Machine (SVM) classifier. It uses top hat transformation and template matching technique.

Mostly researchers are concerned on general condition in traffic Light but few of them are working on the precision of result. Some researchers are working on using the SVM system at night and 2D independent component analysis (2DICA) in and arrow shaped TL using the GABOR walvetTransformation [18].

In the previous researches the researchers are using BCI technique for low level of disability but in this proposal we are upgrading the level of disability. The electrical wheelchair by non-invasive method and the person visually evoked or physically handicapped is able to move from one place to another without the help of any other person so the people with disability can become more reliant [19].

BMW Car makers have developed a parking assist technology in this system internal robotics systems with the combination of sensors are used. This technology cannot be implemented anywhere it requires a specific spot for parking. During parking the system manages itself at least 8inches far from both left and right side of the car. According to data gathered, from sensors, video camera and reflective lens, brakes, accelerator paddle and the steering is also controlled [22]. Mercedes parking assistance systems has implemented in it's new launch series this autonomous technique works by radar technology to vehicle by using radar technology to the vehicle. A radar sensor mounted rear and front of the car checks parking spot whether it is possible to park or not. Once driver stops the car, the driver will get directions showing in form arrows [22]. AUDI Corporation has developed parking guidance system that assist the parking process. The modern parking aid device system for drivers that looks for a suitable space for parking, detection of obstacles in blind holes and gives reliable sound and visual warning's. This system has three steps 1 scanning 2 positioning 3 maneuvering. They implemented this autonomous system using 8 ultrasonic sensors into the bumpers, that detect distance to the obstacle and send measurement of distance to computers dashboard display. According to data processed by computer display unit, it will monitor the driver by showing guidelines in panels. Once the parking spot is identified the computer will compute the path to follow [22]. TOYOTAintelligent Parking System: - This system consists of accurate oriented guidance and tracking algorithm which controls the vehicle parking efficiently [20]. This system works by using 4 ultrasonic sensors implemented into corners of bumpers, a camera installed at rear side and steering sensor. The steering sensor uses steering angle to detect distance of approaching obstacles. This action is performed using SONAR (Sound Navigation and Ranging) detection [22]. Google Self Driving Car: - The car possesses both maps and sensors information to determine where the car is in the world. The car consists of RADAR on the top of the car which emits LASER and are reflected by the objects lying in way of the car travelling and receiving by the sensors mounted on the cars. This process helps the computer to detect the shape and size of object. Then computer decides the way to continue. Then the software choses safe speed and trajectory for car. These cars are electric cars so the response of the car is send towards the Computer This google self-driving car consist of following parts:- GPS system is used to position the car in the whole world, Video camera is used to detect traffic light and signals on the roads, Ultrasonic sensors are attached at the rear left wheel used for actuator control, Central Computer is used to control the speed direction, position and accelerators and brakes. This computer must know the rules of driving [23].

Brain Computer Interfaces and Navigation Devices is a system in which Brain Computer Interface using Asynchronous Brain Computer Interface approach with SSVEP-BCI. With respect to successes rate SSVEP-BCI has high performance. When no decision is provided with presence of stimuli can lead to mental exertion. Because of this reason, Asynchronous Brain Computer Interface Enable or Disable the stimuli can reduce mental exertion, is used. The neuro signals are transferred to classification module, the autonomous car plans and execute action. The menu presents the possible directions those are georeferenced using Global Positioning System (GPS). When new activity is required he or she has to close his eyes in asynchronous Brain Computer Interface [1]. Information Transfer Rate is Calculation of amount of information transferred per unit time, ITR depends on speed & accuracy both [21].

$$B = (1 - L_u) *$$

$$s\left[\log_2 G + L\log_2 L + (1 - L)\log_2\left(\frac{1 - L}{G - 1}\right)\right]$$

Here

G is no. of classes

L rate of undefined classifications

ITR

This performs 60 selections, per minute.

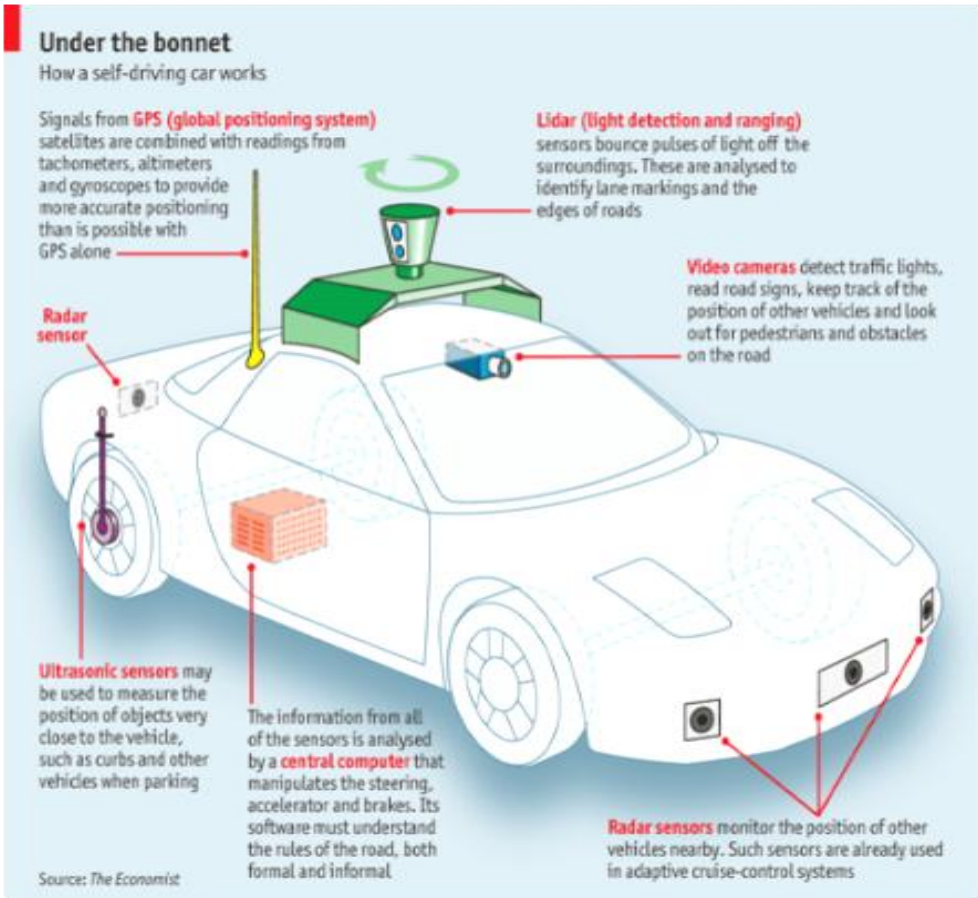


**Fig. 1. The General Structure**

## III. METHODOLOGY

In this section we describe the overall configuration of BIASAV. This proposed model is divided into two parts 1. Autonomous, 2. Semi-Autonomous. This proposed model focuses on providing safe driving conditions and also to provide driving facilities to persons with disabilities. The Autonomous part of this proposed model is used to provide car facilities to persons with disability like autism, physically handicapped, visually evoked potentials, epilepsy and many more. The second part Semi-Autonomous is based on neuro signals of a normal person, this part is not only based on neuro signals but also can hand over the control to computer/ autonomous section in case of emergency. This decreases the risk of accident on roads.

How does brain interact with computer**:**

The Humanbrain consists of parietal lobe, frontal lobe, temporal lobe and occipital lobe. These parts of brain consist of neurons, in these neurons there is a gap known synapse as a path of electrons of Human brain. Bio electrodes are connected in this way that they are able to capture these signals. These signals are bio potential signals used to control computer.

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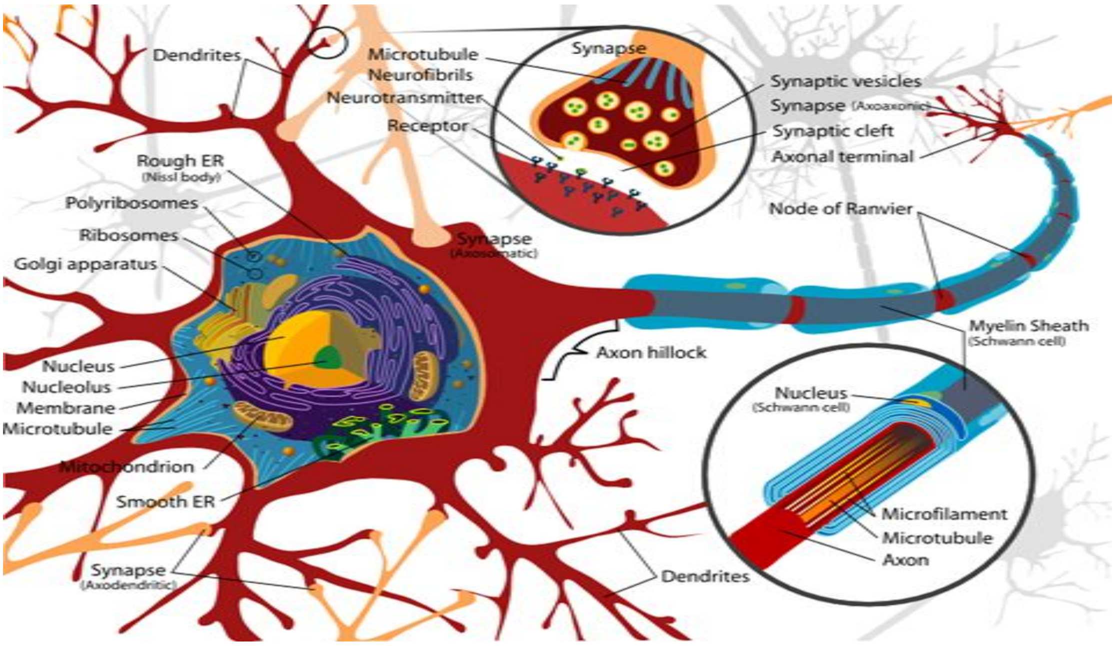


**Fig. 2. The Neuro Cell**

### 3.1 Autonomous

This section of car is used to provide car experience to the people with disabilities. This autonomous section of car divided into several parts.

1. Signal detection**: -** This part of autonomous car is used to read signals coming from human brain. The signals are detected by high intensity micro electrodes which can easily read signals without error. For the purpose of disability this car has a limitation to respond on signals through Brain, so the person should be of low intensity disability. In most of the cases it is observed that the person with disability of AUTISM have no problem in the frontal lobe of brain. This part of brain is used for decision making so this decision of location is transferred to GPS with high accuracy and the GPS system start Guiding the Computer for detection of path. So the computer now performs the function of autonomous car.

$$x_n = \frac{1}{M}\sum_{k=0}^{N-1} Y_k e^{f2\pi kn/N}$$

Where:

$Y_k = encodes\ phase\ and\ amplitude\ of\ componenet x_n$

$M = length\ of\ data.$

$M = 2_k$

2. In case of emergencyas this part of the car is mainly for the persons with disability, in case of emergency like MYOCLONIC JERKS to the person driving this car. So the computer detects intensity of these jerks and send a SMS to the guardians of these people. This Message include location and highest intensity of the jerk, after this message car will find safest and nearest location and parks the car. In case the intensity of jerk is very high and continuous to minute then the computer will let GPS to find nearest Hospital and the computer resends a message indicating name and location of the Hospital.

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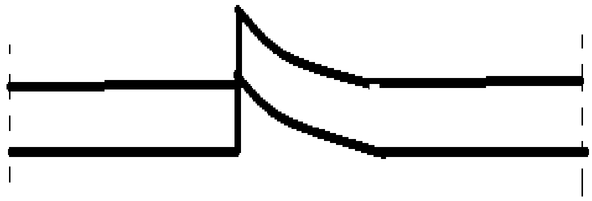

**Fig. 3. Acceptable Neuro Wave form Frequencies**

The above waveform represents the limit of normal wave form for car. This waveform is used as reference to detect jerks and also for input purposes.

The disadvantage of this autonomous cars are low speed, no human emotions, in case of emergency like traffic jam and fire on roads vehicle can lead to change the path and it is very time consuming. In case a person wants to go Washroom the car will not give any response.

To remove these disadvantages, we modified this car as: The GPS system of this car have very high accuracy so in case of emergency like traffic jam, fire on roads detected by RADAR. The GPS will now analysis different routes and shortlist the shortest route not by distance but by time and then take its previous recorded data of traffic condition and current data of the proposed route and forward it to computer then the computer will decide whether to go on this route or not. The pilot seat of this car is not only seat of car but it is a brain interfaced wheel chair and is controlled by artificial intelligence of computer. This system is needed to be mapped so it knows all the routes of home and can easily take person from one place to another.

### 3.2 Semiautonomous

This part of car is used for the purpose of normal drivers. The motive of this part is to reduce risks of accident on roads. This car takes real time data from Human brain and the car is controlled by these Neuro signals, so this car has human emotions. This car has ability to run at higher speed as compared to autonomous. This part of car has an ability to change mode of the car any time with very short time delay any time even while driving. This car is totally based on neuro signals and have ability to become autonomous car.

This mode provides better driving experience to normal persons. Normal persons once in their whole life have to suffer with jerks of epilepsy because epilepsy is nothing but only induced electric potential in brain this causes to jerks. In this case the car will identify shortest route for the hospital and the car will approach that hospital.

Heart attack while driving can cause very damage to surroundings, but this system detects heart attack and parks the car at safest location and takes the person to nearest hospital.

In this method if person has to take phone call then he can transfer this mode to semi-autonomous mode to autonomous mode and can pick call safely.

This Vehicle consists of some modified parts**: -**

Ultrasonic Radar**: -** This system is used to detect obstacles around the car. This sensor consists of bot short and long range Radar

$a = g.\Delta u$

Where: -

a = distance between obstacles

g = speed of sound wave

difference between time pulse, transmission and detection of, reflected signal

ATLD**: -** In this method traffic light is detected by using color detector, this system detects only RED and GREEN light so time delay in this method is very less**.** In this method car computer and traffic light is synchronized using radio signals so computer is able to detect traffic light in traffic jams.

ADI**: -** In this method the cars are synchronized with each other so they can easily respond on acceleration, deceleration and stopping of cars in surrounding detected, by using this method accident on roads can decreased.

AGPS: - This system is an advanced version of Global Positioning System this system searches for new route in case of emergency by analyzing other route by both previous and dynamic data of other route.

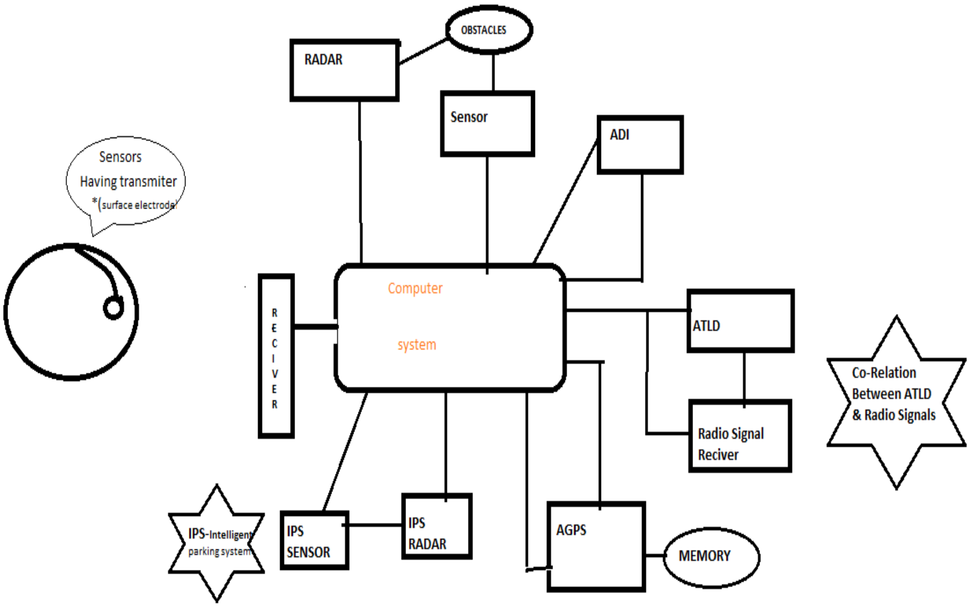


**Fig. 4. Block Diagram of Internal Architecture of BIASAV**

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## IV. RESULTS AND DISCUSSIONS

In this proposed method, we attempt to provide vehicle facilities to persons with disability and also to decrease accidents risks on roads. For this we used brain interference computer technique, some modifications to previous researches. This vehicle system consists of two modes Autonomous & Semi-Autonomous. The Autonomous mode is basically for the persons with disabilities this part of vehicle has approx. 60% accuracy with high level disabilities and 80% accuracy with low level disabilities. Whereas other mode Semi-autonomous has accuracy approx. 85% this mode of is for normal persons. This vehicle consists some modified parts to increase efficiency and reliability of this vehicle. These parts are Ultrasonic Radar consists of both short range and long range. AGPS stands for Advanced Global Positioning System this system is used to identify path accurately using dynamic & previous data. ATLD stands for advanced traffic light detection system this system identifies Traffic light by color detection method and also by Radio Detection Indicator of vehicles in surrounding. The front seat of this car is not only seat but also can be used as wheel chair for the persons with disabilities.

## V. CONCLUSION

This Proposed Method is used to provide driving facilities to persons with disability and also to provide better and safer driving for the persons without disabilities. To achieve this methodology, we used Neuro signals, and also used some modified parts to increase reliability of the car the car also provides the facility of wheelchair to the persons with disabilities.

The driver requires a training session before driving this vehicle the driver with disability have to be trained for 5 hours whereas the normal persons require training of 3 hours. The training session is nothing but classes of Meditation which induces their metal strength

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