e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
( Peer-Reviewed, Open Access, Fully Refereed International Journal )
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

# A REVIEW ON AUTOMATED SELF DRIVING BOT

**Prof. Jayant D. Dorve[*1], Jagruti Dunedar[*2], Paneri Mate[*3], Sejal Wanjari[*4], Tanisha Sawarkar[*5]**

[*1]Asst. Prof, Dept. Of Electronics And Telecommunication, Priyadarshini J.L College Of Engineering, Nagpur, India.

[*2,3,4,5]Students, Dept. Of Electronics And Telecommunication, Priyadarshini J.L College Of Engineering, Nagpur, India.

## ABSTRACT

Nowadays development of automated BOT gained a lot of interest of most of researchers. Automated BOT has ability to sense surrounding environment and navigate without any human intervention. The potential benefits of automated BOT include reduction in infrastructure cost, increased safety with significant reduction in traffic collisions. This paper introduces the automated robot which is a scaled down version of actual self-driving BOT and designed with the help of neural network. The main focus is on building automated robot and train it on a designed track with the help of neural network so that it can run automatedly without a controller or driver on that specific track.

**Keywords:** Self Driving BOT**,** AVR Microcontroller, ESP32, Motor Driver, Etc.

## I. INTRODUCTION

The Automated Self-Driving Bot is a robotic vehicle which will automatically navigate and sense various activities without any human interventions or supervision. It uses various sensors, camera, I/O devices interfaced with microcontroller(s) to sense process and act on collected data. The bot can navigate with the help of traffic sign boards and road-lanes using camera-vision and various sensors. To interact and process data from various sensors an 8-bit Microchip's AVR ATmega8A/L microcontroller is used which will read various analog and digital signals from multiple sensors such as LDR, alcohol sensor, ultrasonic distance sensor, etc. For the camera-vision and RF a 32-bit advance dual Xtensa-core based ESP32 microcontroller is used which is able to capture continuous camera frames with better enough frame-rate from a MIPI camera and stream it over a n/w via TCP-IP sockets through the local n/w (WiFi routing). The streamed camera-frames are need to be processed on a server or a host machine like laptop/desktop due to limitations of resources in ESP32 microcontroller. Due to limited computing horse-power (memory & CPU speed) the ESP32 cannot do a real-time object detection and recognition. For sign board detection host server/machine uses various DIP and computer-vision algorithms such as color-domain conversion, HSV/B filtering, Contours Detection, Contour Approximation, etc. In order to accurately classify and identify various types of sign boards a pre-trained Convolutional Neural-Network (CNN) is used which will label/classify sign boards according to their classes to which they belong to.

For wireless/RF communication the bot uses two methods as WiFi/WLan and BLE (Bluetooth-Low- Energy) which are connected within the local n/w. This wireless RF stack is a part of ESP32 which consumes less power. For other sensor monitoring and output devices controlling a separate low-power 8-bit microcontroller ATmega8A\L is used which will take care of all the input/output digital signals from/to various sensors and devices. To automatically control headlights during night-time a LDR (Light Dependent Resistor) sensor is used which will give analog signals to the microcontroller. For lane detection a pair of LDR sensors and LEDs are used along with an Op-Amp as a comparator. The bot also uses an alcohol sensor which is interfaced with the same ATmega8A/L microcontroller in order to control the bot ignition in case of alcohol detection. For object detection a ultrasonic distance sensor is used which is again interfaced with microcontroller ATmega8A/L via two of its GPIOs. This object detection sensor will detect an object and will control the bot's movement.

## II. LITERATURE SURVEY

1. R Okuda, Y Kajiwa VLSI Design automation, "A survey of technical trend of ADAS and autonomous driving", 2014 -ieeexplore.ieee.org

This paper gives a brief survey of technical trend of ADAS and autonomous driving focusing on algorithms actually used for autonomous driving prototype cars. For past 10 years Advanced Driving Assistance System

(ADAS) has rapidly grown. Recently not only luxury cars but some entry level cars are equipped with ADAS applications, such as Automated Emergency Braking System (AEBS). The European New Car Assessment Program (Euro NCAP) announced its introduction of AEBS test from 2014, which will accelerate the penetration of ADAS in Europe. Also DARPA challenge started from 2004 accelerated the research for autonomous driving. Several OEMs and universities have demonstrated autonomous driving cars.[1]

2. Taylor J Millar , "An ethics evaluation tool for automating ethical decision-making in robots and self- driving cars"; Applied artificial intelligence, vol 30 Issue 8 2016

This paper proposes some general ethical requirements that should be taken into account in the design room, and sketches a design tool that can be integrated into the design process to help engineers, designers, ethicists, and policymakers decide how best to automate certain forms of ethical decision-making. As we march down the road of automation in robotics and artificial intelligence, we will need to automate an increasing amount of ethical decision-making in order for our devices to operate independently from us. But automating ethical decision-making raises novel questions for engineers and designers, who will have to make decisions about how to accomplish that task. For example, some ethical decision-making involves hard moral cases, which in turn requires user input if we are to respect established norms surrounding autonomy and informed consent. The author considers this and other ethical considerations that accompany the automation of ethical decision-making.[2]

3. A Vriza, H Chan, J Xu - Chemistry of Materials, "Self-driving laboratory for polymer electronics", 2023 - ACS publication

This paper proposes owing to the chemical pluripotency and viscoelastic nature of electronic polymers, polymer electronics have shown unique advances in many emerging applications such as skin-like electronics, large-area printed energy devices, and neuromorphic computing devices, but their development period is years-long. Recent advancements in automation, robotics, and learning algorithms have led to a growing number of self-driving (autonomous) laboratories that have begun to revolutionize the development and accelerated discovery of materials. In this perspective, we first introduce the current state of autonomous laboratories.[3]

4. R Kummerle, D Hahnel, D Dolgov Automation, "Autonomous driving in a multi-level parking structure", 2009 - ieeexplore.ieee.org

This paper, we present an approach for autonomous navigation of cars in indoor structures such as parking garages. Our approach utilizes multi-level surface maps of the corresponding environments to calculate the path of the vehicle and to localize it based on laser data in the absence of sufficiently accurate GPS information. It furthermore utilizes a local path planner for controlling the vehicle. In a practical experiment carried out with an autonomous car in a real parking garage we demonstrate that our approach allows the car to autonomously park itself in a large-scale multi-level structure.[4]

5. H Bai, S Cai ,N Ye, D Hsu, "Intention-aware online POMDP planning for autonomous driving in a crowd", 2015 - ieeexplore.ieee.org

This paper presents an intention-aware online planning approach for autonomous driving amid many pedestrians. To drive near pedestrians safely, efficiently, and smoothly, autonomous vehicles must estimate unknown pedestrian intentions and hedge against the uncertainty in intention estimates in order to choose actions that are effective and robust. A key feature of our approach is to use the partially observable Markov decision process (POMDP) for systematic, robust decision making under uncertainty. Although there are concerns about the potentially high computational complexity of POMDP planning, experiments show that our POMDP-based planner runs in near real time, at 3 Hz, on a robot golf cart in a complex, dynamic environment. This indicates that POMDP planning is improving fast in computational efficiency and becoming increasingly practical as a tool for robot planning under uncertainty.[5]

## III. PROBLEM STATEMENT

Accidents the total fatality rate would be virtually eliminated. Traffic and congestion problems would be eliminated. Heavy loads would easily travel to longer destinations without the need for a driver. Driver monitoring systems in self-driving BOT would help keep on their safety. Shifting of heavy loads would be completely changes people would not be entitled to learn driving.

## IV. PROPOSED BLOCK DIAGRAM

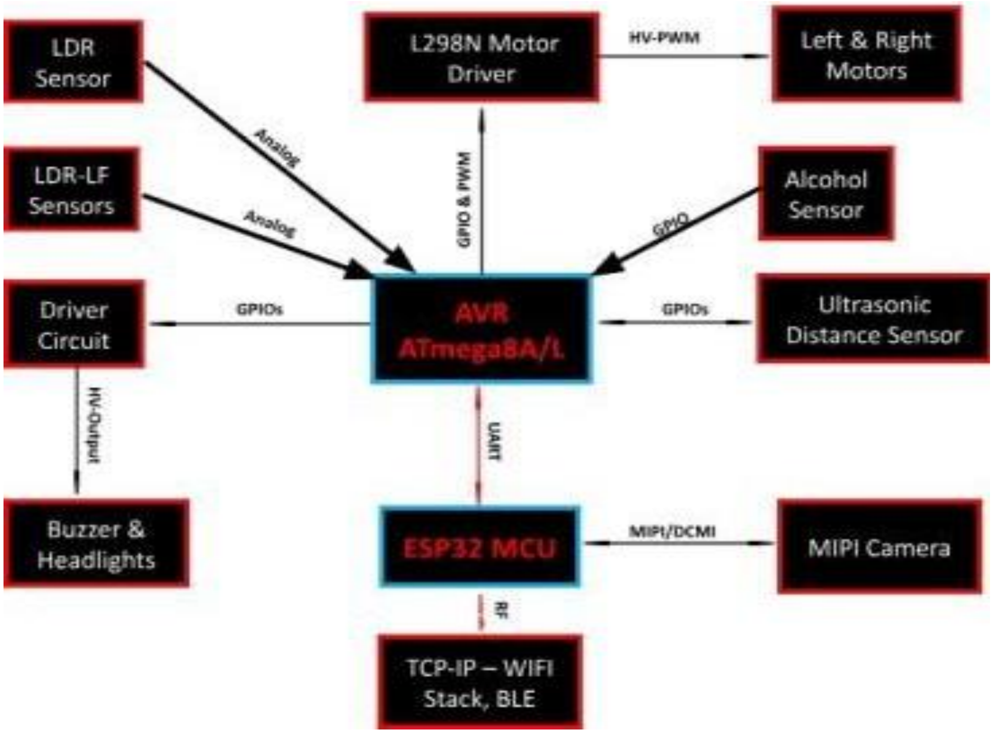


**Fig 1.** Proposed Block Diagram of Automated Self Driving BOT

## V. METHODOLOGY

The Self Driving Bot is an autonomous four wheeled bot which uses embedded systems, computer vision, and AIML to control, navigate, and drive itself without any human control or supervision. As showed in block diagram it uses various I/O devices, sensors, and control units each of them connected and works uniquely for different things. The overall I/O system is governed by the 8-bit AVR microcontroller ATmega8A/L to which all the I/O devices and ESP32 MCU is connected. In order to process images and perform computer vision in real-time a continuous stream of live frames is required which is captured by MIPI camera attached to ESP32 MCU. The camera is attached to ESP32 MCU as because the 8-bit AVR microcontroller is not powerful enough to interface and drive camera. The ESP32 MCU also has a WiFi and BLE RF stack for low-power high-speed wireless communication through which it wirelessly interfaces with host-computer/server for image processing/AIML and Android devices for user-control. This ESP32 MCU is interfaced with AVR through UART serial communication.

The bot also consists of various sensors which is directly interfaced with AVR microcontroller. One LDR sensor is used to detect darkness in order to automatically control Headlights. Two more LDR sensors are used for Lane-Following. These all LDRs are interfaced with AVR through few of its internal ADC (Analog-to-Digital Converter) input pins. It also uses a HCSR04 ultrasonic distance sensor which is interfaced with AVR through two of its GPIOs. This sensor is used to detect an object in front of bot in order to control it. It uses two digital signal pins as Trig & Echo which out of which one is input and other is output. For more safety purpose a MQ3 alcohol sensor module is used. This sensor detects the presence of alcohol gas and sends signal accordingly to the AVR which then controls the bot. The MQ3 module is having two output/interfaces those are digital output and analog output out of which digital output is used as it is having op-amp based comparator on-board with set-point preset so it is interfaced with the AVR through a single GPIO pin.

There are few output devices are connected to the same AVR microcontroller and those are motors (through driver circuit), LEDs, Headlight (through driver circuit), Buzzer (through driver circuit), etc. A motor driver is required because the DC motors sinks more power as it is electro-magnetic. The motor driver used is L298N which is interfaced with AVR microcontroller through six of its GPIOs out of which four GPIOs are used and configured as a digital output to control direction of two motors and two GPIOs are used and configured as a PWM output in order to control speed on two motors. For indication purpose a signal LED is used which is connected to one of the GPIO of AVR which blinks after every few seconds which indicates heart-beat of the system. For alert purpose a 5v piezo-electric buzzer is used which is connected through the driver circuit to the AVR's GPIO. As the buzzer requires more current at 5v so a NPN transistor-based CE driver circuit is used which gains/controls the current through the buzzer with minimum current at its input (sourcing current of AVR's GPIO). The headlights (High power LEDs) are connected to the AVR's GPIO through a driver circuit as well. This headlight driver uses a Darlington pair NPN transistor in CE mode which is same as the normal NPN-CE driver but having more power handling capacity and better gain factor. The Darlington's base is driven through one of the GPIO of AVR microcontroller. The overall system is powered through three different voltage sources as 3.3v, 5v, and 11.1v. As the system is having different devices which operates on different voltages so these various supply voltages are required. To get 11.1v power supply it uses 3x 3.7v Lithium-Ion batteries. This 11.1v is used by the motor driver in order to drive motors at with higher torque and better RPM. The same 11.1v is further reduced to 5v with the help of DC-to-DC buck converter. This 5v is required by various devices, sensors, etc. such as AVR microcontroller, sensors, headlight driver, etc. The same 5v is given to the ESP32 MCU dev-kit which is having on-board 3.3v LDO (Low Drop Out) voltage regulator.

The AVR microcontroller is programmed in AVR Embedded-C through AVR-GCC toolchain. The ESP32 MCU is programmed through Arduino platform and Arduino libraries. For computer vision and AIML a Python based programming is used. The CV and AIML part use various high-level Python libraries, packages such as numpy, OpenCV, PyTorch, PySerial, etc.

## VI. HARDWARE AND SOFTWARE REQUIREMENT

**HARDWARE**

- AVR ATmega8A Microcontroller
- ESP32-CAM Dev-Kit
- L298N Motor Driver
- HCSR04 Ultrasonic Sensor
- Geared DC Motors + Wheels
- LDR Sensors
- MQ-3 Alcohol
- Small 5v Buzzer
- Led
- 3.7v lithium-Ion Battery
- Resistors
- Capacitors
- Lithium-Ion Battery Container
- Dc-to-Dc Buck Converter

**SOFTWARE**

- Microchip AVR Studio 7
- Espressif-IDE Studio
- Proteus 8 Professional
- Prog-ISP 172
- Pulse View
- Serial Terminal/Monitor

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
( Peer-Reviewed, Open Access, Fully Refereed International Journal )
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

**FLOWCHART**

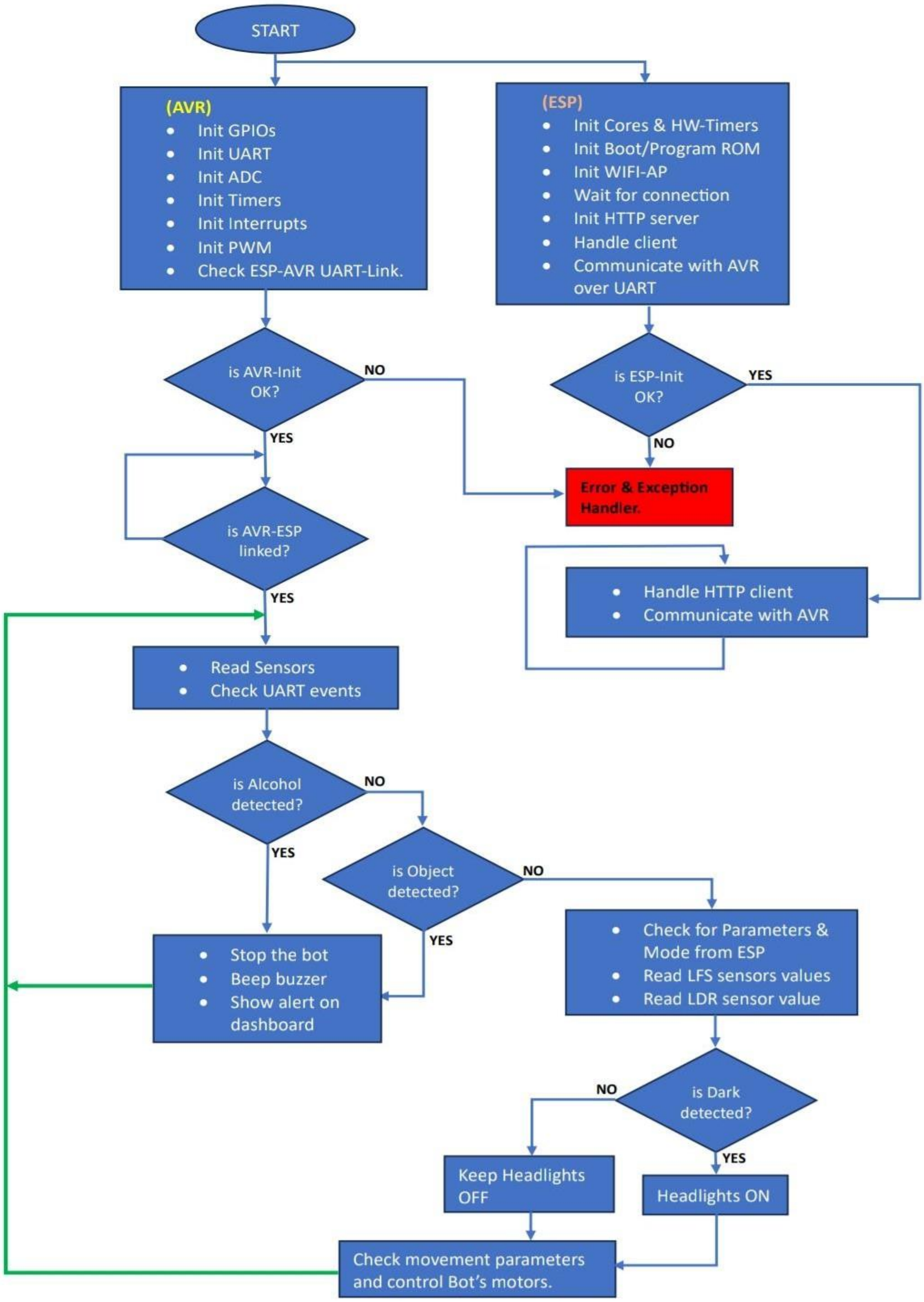


**Fig.2** Flowchart of Automated Self Driving BOT

## VII. CONCLUSION

In this project a simple prototype of a self driving car will be demonstrated. The specific car will recognize three separate signals - turn left, turn right and stop with great accuracy and take decision accordingly using AI. The prototype can be further improved by including more signals and using ML approach.

IRJMETS
e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
( Peer-Reviewed, Open Access, Fully Refereed International Journal )
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

## VIII. FUTURE SCOPE

The Future of self driving BOT, also known as Automated vehicles or driverless cars, is an exciting and rapidly envolving field. These vehicles have the ability to improving safety factor, reduce traffic congestion, and increase mobility for those who are unable to drive.

## IX. REFERENCES

[1] "A survey of technical trend of ADAS and autonomous driving" ,R Okuda, Y Kajiwa VLSI Design, Automation 2014 - ieeexplore.ieee.org

[2] "An ethics evaluation tool for automating ethical decision-making in robots and self-driving cars"; Taylor J Millar ,Applied artificial intelligence, 2016

[3] "Self-driving laboratory for polymer electronics ,"A Vriza, H Chan, J Xu - Chemistry of Materials, 2023 - ACS publication.

[4] "Autonomous driving in a multi-level parking structure", R Kummerle, D Hahnel, D Dolgov Automation, 2009 - ieeexplore.ieee.org

[5] "Intention-aware online POMDP planning for autonomous driving in a crowd", H Bai, SCai,N Ye, D Hsu 2015 - ieeexplore.ieee.org

[6] "Recent Perspectives on the impact of Autonomous Self Driving Robotic Cars", Dalma Zilahy, 2022.

[7] "Autonomous Self Driving Robotic Cars", Gyula Mester, 2021

[8] "Artificial Intelligence based Self-Driving Car", H Thadeshwar, Vinit Shah, Mahek Jain, R Chaudhari, V Badgujar, 2020 – ieeexplore.org