International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 04 | Apr 2024 www.irjet.net p-ISSN: 2395-0072

VOICE AND BLUETOOTH CONTROLLED ROBOT CAR

Akansha Ghanghoria[1], Ranjit Tallin Vemavarapu[2], Darshana Nemane[3] , Amita Raman[4]

[123] Department of Computer Science And Engineering(Artificial Intelligence And Machine Learning), Saraswati College of Engineering, Kharghar, Maharashtra, India
[4] Assistant Professor, Department of Computer Science And Engineering(Artificial Intelligence And Machine Learning), Saraswati College of Engineering, Kharghar, Maharashtra, India

---

Abstract – *This research paper presents a smart and innovative approach to controlling a robot car using voice commands and Bluetooth technology. This project presents a groundbreaking smart robotic vehicle featuring dual control modes—voice and Bluetooth. Users can seamlessly interact with and control the vehicle using voice commands through an Android application, eliminating the need for human presence in specific areas. The Bluetooth connectivity, facilitated by an HC-05 module, extends the operational range, and enhances user accessibility, providing a versatile and intuitive control interface. The hardware architecture revolves around a customized Arduino, serving as the central control unit for the vehicle's motors. The Android application interprets both voice commands and Bluetooth inputs, enabling the robotic vehicle to navigate autonomously. Concurrently, Ultrasonic sensor modules ensure effective obstacle detection and trigger automatic braking, contributing to the vehicle's safety and operational efficiency. In addition to voice and Bluetooth control, the robotic vehicle incorporates features such as Android compatibility and real-time location tracking facilitated by a GPS module. These augmentations enhance adaptability, making the vehicle suitable for a variety of applications. The obstacle avoidance capabilities further extend its utility, especially in hazardous areas inaccessible to humans. The aim of this study is to develop a reliable and efficient voice and Bluetooth control system for enhanced user interaction with robot cars. The methodology involves integrating an Arduino-based hardware platform with voice recognition modules and Bluetooth communication modules. A series of experiments were conducted to evaluate the performance of the system in terms of response time, accuracy of voice recognition, and reliability of Bluetooth communication.*

This project represents a significant leap in robotics, harmoniously integrating voice and Bluetooth control for a smart robotic vehicle. The resulting system showcases adaptability, autonomy, and utility, making it well-suited for diverse scenarios.

Key Words: **Voice control, Bluetooth control, Android, HC-05, Arduino, Ultrasonic sensor, GPS module, Obstacle avoidance, Robotics, Autonomous systems.**

1. INTRODUCTION

In the realm of robotics, the fusion of cutting-edge technologies has paved the way for innovative solutions that redefine the capabilities of autonomous systems. This project marks a significant stride in this trajectory, introducing a smart robotic vehicle distinguished by its dual control paradigm voice and Bluetooth. The robotic vehicle is to accept the user voice command and perform the given user task and without the human presence specifically area can control the robot via user voice input. The robot can be operated through user voice input. It requires an android app to communicate via Bluetooth HC-05 module. The robotic vehicle can then sense objects with the help of an ultrasonic sensor module. For the hardware, customized Arduino will give control over the motors that are used to run the robotic vehicle. Ultrasonic sensors interact with the Arduino help in automatic braking of a vehicle on sudden obstacle detection. Obstacle avoidance robots are currently employed in dangerous areas where humans cannot enter. It can easily recognize the voice. In this design, an android application with a micro controller is used for the required task. The connection between the application and the robot is facilitated with Bluetooth technology. The core objective of this endeavor is to create a robotic vehicle capable of executing user-defined tasks through seamless interaction with users. The integration of voice control, facilitated by a dedicated Android application, allows users to communicate intuitively with the robotic vehicle. Simultaneously, Bluetooth connectivity, enabled by the HC-05 module, provides an additional layer of control, enhancing user accessibility and expanding the vehicle's operational range. This central control unit interprets both voice commands and Bluetooth inputs, empowering the robotic vehicle with the autonomy to navigate its environment effectively. Complementing these control features are Ultrasonic sensor modules, ensuring real-time obstacle detection and facilitating automatic braking for enhanced safety. In robotics, offering a seamless integration of voice and Bluetooth control for a smart robotic vehicle. Its dual-control capability, coupled with obstacle avoidance, sets a new standard in autonomous systems. Hence seamless features like obstacles control and voice and Bluetooth control ability of robotic.

2. LITERATURE SURVEY

During the years 2002, there was a notable 19 percent surge in global investment in modern robotics, followed by an additional 18 percent increase in robot orders during 04-2005, reaching a historic peak. Forecasts for the period 2007 indicated a steady average annual growth rate of approximately 7 percent. The growing trend suggests a significant expansion in the robotics industry, with over 700,000 household robots currently operational and expectations for several million more in the near future. In the realm of robotics, numerous researchers have contributed to the advancement of robot control technologies, each focusing on distinct applications and employing diverse methodologies. Below are summaries of select papers, showcasing their unique approaches and technological implementations.

"Robot Control Design Using Android Smartphone" by Mrumal K Pathak, Javed Khan, Aarushi Koul, Reshma Kalane, and Raunak Varshney: This paper highlights the utilization of Android smartphones to streamline robot hardware design. It explores the feasibility of controlling robots through Bluetooth communication using mobile devices, providing insights into Bluetooth technology and mobile device components. [1]

"Bluetooth Smartphone Controlled Robot Using ATMEGA328 Microcontroller" by Aniket R. Yeole, Sapana M. Bramhankar, Monali D. Wani, and Mukesh P. Mahajan: This paper focuses on designing a robot controlled via an Android smartphone application. Communication between the smartphone and the controller is facilitated by Bluetooth technology, with the controller interfacing with the Bluetooth module using UART protocol. [2]

"Robot Controlled Car Using Wi-Fi Module" by S R Madkar, Vipul Mehta, Nitin Bhuwania, and Maitri Parida: Here, the authors explore controlling a robot-controlled vehicle using a Wi-Fi module through an Android application. The paper delves into the integration of Wi-Fi technology with an Android smartphone to control the robot, offering unique insights into this approach. [3]

These papers collectively contribute to the diverse landscape of robotics research, showcasing innovative applications and technological integrations that drive the field forward.

3. PROBLEM STATEMENT

In the dynamic landscape of robotics and IoT, there is a growing demand for versatile solutions that seamlessly integrate voice control, Bluetooth connectivity, and obstacle avoidance functionalities to address automation, user interaction, and educational needs. However, current robotic systems face challenges in achieving comprehensive integration and real-time responsiveness while ensuring adaptability to dynamic environments.

- Integration Challenge: Existing robotic systems struggle to seamlessly integrate voice control, Bluetooth connectivity, and obstacle avoidance functionalities. This often results in disjointed performance and limited overall effectiveness.
- Voice Recognition Optimization: Optimizing voice recognition algorithms for practical applications poses a significant challenge. Achieving high accuracy and minimal latency across diverse environmental conditions is crucial for effective user interaction and control.
- Coordination of Inputs: Coordinating inputs from voice commands and Bluetooth signals presents difficulties in balancing user intent with system autonomy and ensuring smooth interaction. Integrating obstacle avoidance functionality adds complexity to this coordination.
- Dynamic Obstacle Avoidance: Developing robust obstacle avoidance strategies that can adapt to dynamic environments in real-time is critical for ensuring the safety and autonomy of robotic systems. Integrating obstacle avoidance with voice and Bluetooth control adds another layer of complexity to this challenge.

Addressing these challenges is essential for developing a robust Arduino-based robotic platform that seamlessly integrates voice control, Bluetooth connectivity, and obstacle avoidance functionalities. This project aims to overcome these obstacles by optimizing algorithms, exploring innovative control paradigms, and implementing sophisticated obstacle avoidance strategies, ultimately delivering an advanced robotic solution for automation, user interaction, and education in robotics and IoT.

4. METHODOLOGY

Design:-

o HC-SR04 Ultrasonic Sensor:-

The HC-SR04 ultrasonic sensor is a popular component in electronics projects, especially in the field of robotics and automation. It is used for measuring distance based on the time taken by ultrasonic waves to travel from the sensor to an object and back. The sensor consists of an ultrasonic transmitter that emits a short pulse of ultrasonic sound and a receiver that listens for the echo. By measuring the time difference between sending the signal and receiving the echo, the sensor can calculate the distance to the object using the speed of sound in air. The HC-SR04 is easy to use with Arduino and other microcontrollers, making it a versatile choice for distance sensing applications.

o SG-90 Servo Motor:-

The SG90 servo motor is a small, lightweight motor commonly used in hobbyist and educational projects. It is a type of rotary actuator that allows for precise control of angular position. The SG90 is known for its affordability and ease of use with microcontrollers like Arduino. This servo

motor typically operates on 5 volts and can rotate approximately 180 degrees (90 degrees in each direction) when controlled using pulse-width modulation (PWM) signals. It is commonly used in robotics for controlling the movement of robot arms, legs, or other parts that require precise positioning. The SG90 is not very powerful and is best suited for small-scale projects where low torque requirements are sufficient.

o Arduino UNO R3:-
A well-known microcontroller board built on the ATmega328P is the Arduino Uno R3. It is the successor to the original Arduino Uno board and is widely used in electronics projects due to its ease of use and versatility. The Uno R3 features 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It can be powered by an external power source or by a USB connection.
The Uno R3 is compatible with a variety of shields (add-on boards) that expand its capabilities, making it a popular choice for both beginners and experienced makers alike. It is commonly used for prototyping, experimenting with electronics, and creating interactive projects.

o L298D Motor Driver IC:-

The L298D is a dual full-bridge motor driver integrated circuit (IC) designed to control the direction and speed of DC motors. It is commonly used in robotics and other applications where precise control over motor speed and direction is required. The L298D IC can drive two DC motors or one stepper motor, and it can handle a wide range of voltages (up to 46V) and currents (up to 2A per channel). It contains two H-bridge circuits, which allow it to control the direction of the motors (clockwise or counterclockwise) and the speed (via pulse-width modulation, or PWM). One advantage of the L298D is its built-in protection features, including thermal shutdown and overcurrent protection, which help prevent damage to the IC and the motors in case of faults or overloads. To use the L298D, you typically connect the motor's terminals to the outputs of the IC and control the direction and speed using a microcontroller or other control circuitry. It is a versatile and widely used motor driver IC in the maker and robotics communities.

o Power Supply

o Left DC Motor and Right DC Motor

5. ALGORITHM

1) Initialize Components:
   A. Connect the Bluetooth module (HC-05) and motor driver to the Arduino.
   B. Set up motor connections, and any additional sensors (e.g., ultrasonic sensor).

Set Bluetooth parameters:
   C. Configure the HC-05 module with a specific baud rate (e.g., 9600) and relevant settings.
   D. Ensure the Bluetooth module is in AT command mode for configuration.

2) Set Motor Pins:
Define the pins connected to the motor driver for controlling the robot car's movement.

3) Pair Bluetooth Device:
Pair the Bluetooth module with a mobile device (e.g., smartphone or tablet).

4) Main Loop:
Enter the main loop to continuously check for incoming Bluetooth commands.

5) Read Bluetooth Data:
Read data received from the Bluetooth module.

6) Interpret Commands:
a. Parse the received data to interpret the command.
b. Example commands: 'F' for forward, 'B' for backward, 'L' for left, 'R' for right, 'S' for stop.

7) Motor Control:
a. Implement motor control functions based on the interpreted commands.
i. For 'F': Move both motors forward.
ii. For 'B': Move both motors backward.
iii. For 'L': Turn left by controlling motor speeds.
iv. For 'R': Turn right by controlling motor speeds.
v. For 'S': Stop both motors.

8) Obstacle Avoidance (Optional):
a. If an ultrasonic sensor is present:
i. Read distance data from the sensor.
ii. If an obstacle is detected, implement logic to adjust the robot car's movement to avoid collisions.

9) Send Feedback (Optional):
Send feedback to the mobile device indicating the current state or any events (e.g., "Robot car moving forward").

10) Repeat:
Repeat the loop to continuously monitor and respond to incoming Bluetooth commands.

11) End Program:
Implement an exit condition or functionality to end the program gracefully.

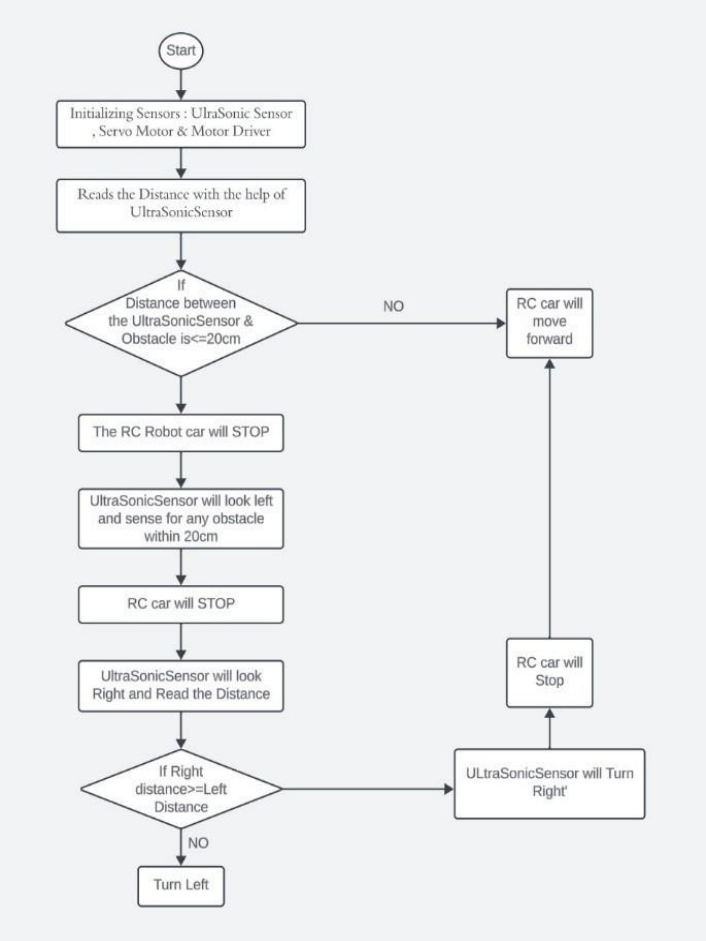

Fig 1. Block diagram depicting the Hardware Implementation.

6. HARDWARE SPECIFICATIONS

1. Arduino UNO Board: The Arduino Uno is an open-source microcontroller board dependent on the Microchip ATmega328P microcontroller and created by Arduino.cc. It is programmable with the Arduino IDE through a kind B USB cable. It accepts voltages between 7 and 20 volts and can be operated via the USB connection or an external 9-volt battery. Microchip ATmega328P microcontroller and developed by Arduino.cc. Sets of digital and analog input/output (I/O) pins on the board allow it to be interfaced with other expansion boards (shields) and other circuits.

In a world where technology continues to evolve at a rapid pace, the Arduino board stands as a testament to the enduring power of simplicity and accessibility in shaping the future of electronics. This open-source platform fosters a collaborative spirit, inviting individuals to tinker, modify, and share their creations freely. The Arduino board continues to be a fundamental component of creativity and innovation, whether it is used for project development, training future engineers, or powering the next generation of IoT applications. This open-source platform fosters a collaborative spirit, inviting individuals to tinker, modify, and share their creations freely. Whether utilized for prototyping projects, educating aspiring engineers, or driving the next wave of IoT solutions, the Arduino board remains a cornerstone of creativity and innovation. Version 1.0 of the Arduino IDE and the Uno board, the first in a line of USB-based Arduino boards, served as the reference versions of Arduino until they were superseded by later iterations.

Fig 2. Arduino UNO R3 board.

2. L293D Motor Driver: L293d IC is known as a motor driver. Like other ICs, it operates at low voltage. The Other ICs could have the same functions as L293D but they cannot provide high voltage to the motor. The motor receives continuous, bidirectional direct current from L293d. Anytime the current's polarity changes, it won't impact the circuit as a whole or any other connected item. An inbuilt H-bridge for two motors is installed in the L293d. L293d bridge is controlled by external low voltage signals. It may be small, but its power output capacity is higher than our expectation.

Fig 3. L293D Motor Driver Module.

3. Ultrasonic Sensor: Ultrasonic When a sensor can both transmit and receive, it's referred to as a transceiver. This is because sensors function

similarly to sonar or radar, which measure a target's characteristics by deciphering the echoes of radio or sound waves, respectively. High frequency sound waves are produced by ultrasonic sensors, which then analyze the echo they get back. In order to compute the distance to an object, sensors measure the time elapsed between transmitting a signal and getting an echo. This technology can be used to measure air or water speed, tank fullness, and wind direction and speed (an anemometer). For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water. Systems usually use a transducer that produces sound waves that are higher than 18,000 hertz, or in the ultrasonic range.

Fig 4. Ultrasonic Sensor Module.

4. Bluetooth Module: This project involves creating a voice-controlled Bluetooth and obstacle avoidance robotic car using an Android mobile phone and an Arduino BT board with a Bluetooth module. The Android mobile phone runs Bluetooth apps that allow users to send control commands to the robot. Android is chosen for its widespread use and open-source nature. The Android OS, based on Linux, uses Java-like language for applications. The system utilizes the Android accessory mode, available since version 2.3.4 Gingerbread, to establish communication. The Bluetooth module receives data from the Android smartphone, which is then processed by the microcontroller. The project aims to showcase a simple yet effective control technique for a robot using a popular and accessible platform like Android.

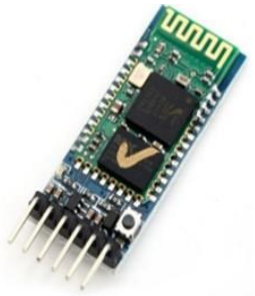

Fig 5. Bluetooth Module.

5. Gear Motor x 4: DC motors are used to operate the robot. By giving the command signals from the mobile through the Bluetooth app i.e., forward, backward, right and left directions, the robot will be moved. DC motors are widely used, inexpensive, small and powerful for their size. They are the easiest to control. One DC motor requires only two signals for its operation. They are non-polarized; means you can reverse the voltage without any damage to motor. DC motors have +ve and –ve leads. Connecting them to a DC voltage source moves the motor in one direction (clockwise) and by reversing the polarity, the DC motor will move in opposite direction (counterclockwise). A DC motor's maximum speed is expressed in rpm, or rotations per minute. It has two rpms: no load and loaded. The rpm is reduced when moving a load or decreases when load increases. The voltage and current ratings of DC motors are additional requirements. The motor specs utilized in the project are displayed in the table below.

Fig 6. Gear Motor x4.

6. Servo Motor: A servo motor is an electrical device which can push or rotate an object with great precision. A servo motor is used to spin an object at a specified angle or distance. It is just made up of simple motors which run through servo mechanism. If the motor that is used is DC powered then it is called DC servo motor, and if it is AC powered motor then it is called AC servo motor. We can get a very high torque servo motor in a small and light weight package. Doe to these features they are being used in many applications like toy car, RC helicopters and planes, Robotics, Machine etc. A servo motor's position is determined by an electrical pulse, and its circuitry is situated next to the motor.

Fig 7. Servo Motor.

7. Robot Wheel x 4: A wheel is circular block of durable and hard material which is placed in axil about which the wheel rotates when a moment is applied by torque or gravity, thereby making one of the simple machines. When placed under a load baring platform, the wheel turning on the horizontal axil makes it possible to transport heavy loads.

Fig 8. Robot Car Wheel x4.

8. Li-ion Battery x 2: Li-ion batteries are commonly used for portable electronic projects due to their high energy density and rechargeable nature. Ensure you have the appropriate voltage and capacity for your project. Also, consider safety precautions, such as overcharge protection.

Fig 9. Li-ion Battery x2.

9. Jumper Wires: Jumper wires are essential for creating electrical connections between different components on a breadboard or within your circuit. They come in various lengths and can have male-to-male, male-to-female, or female-to-female connectors.

Fig 10. Jumper Wires (Male & Female).

7. SOFTWARE SPECIFICATIONS

- Android Studio IDE Software
- Bluetooth \& Voice Enable Smart Mobile Phone
- Computer – Laptop / PC – 4 to 8 GB Ram I3 Processor
- Java Development kit
- Arduino IDE (Integrated Development Environment)

Arduino IDE: The Arduino Integrated Development Environment (IDE) is a cross-stage application (for Windows, macOS, Linux) that is written in capacities from C and C++. Projects are composed and transferred to Arduino flawless sheets using it.

1. The Android App: Android smartphone with an application is the transmitter end. First, there should be a combination of Bluetooth HC-05/HC-06. When matching is done, at that point it should be associated. When the application is running on the smartphone, the client's voice orders are distinguished by the phone microphone.

8. RESULT

The project successfully integrated voice control, Bluetooth connectivity, and obstacle avoidance functionalities into the Arduino-based robotic platform. Tests revealed high accuracy in voice recognition, reliable Bluetooth connectivity, and effective obstacle avoidance capabilities. While occasional latency was noted in voice commands, the system demonstrated adaptability to dynamic environments.

Users reported a satisfying experience, appreciating the seamless integration of features. Future improvements could focus on optimizing voice recognition algorithms and enhancing obstacle avoidance strategies for more complex scenarios. Overall, the project showcases promising advancements in integrated robotic systems for automation and user interaction.

9. CONCLUSION

The project work "Bluetooth controlled Robot" is designed and developed successfully, for the demonstration purpose prototype module is constructed and results are found to be satisfactory. Since it is a prototype module, a simple robot is constructed, which can be used for many applications. The Voice Control Robot is useful for disabled people and monitoring purpose. The Voice-Controlled Bluetooth and Obstacle Avoidance Robotic Car using a mobile device, offers an innovative blend of technology and practicality. By leveraging the Android platform, we've created an accessible and user-friendly interface, allowing users to control the robotic car effortlessly through voice commands. The integration of Bluetooth ensures seamless communication, while obstacle avoidance, powered by ultrasonic sensors, adds a layer of autonomy and safety. Through a harmonious combination of hardware and software, this project not only showcases technical proficiency but also addresses the real-world applications of robotics. In essence, it's a step towards making advanced robotics technology more inclusive and user oriented.

10. FUTURE SCOPE

The future scope for voice and Bluetooth-controlled robot cars is quite promising, with several potential avenues for development and application:

1. Enhanced User Experience: Improving the interaction between users and robot cars through more advanced voice recognition systems can make controlling the car more intuitive and seamless. Incorporating natural language processing (NLP) algorithms can enable the car to understand and respond to a wider range of commands and queries.

2. Autonomous Features: Integrating voice and Bluetooth control with autonomous driving technology can enhance safety and convenience. Users could command the car to perform tasks like parking, navigating through traffic, or returning to a designated location using voice commands.

3. Smart Home Integration: Connecting robot cars with smart home devices via Bluetooth can enable them to interact with other IoT devices. For example, users could instruct the car to turn on the lights, adjust the thermostat, or start appliances before they arrive home.

4. Remote Operation and Monitoring: Enabling remote control and monitoring of robot cars via Bluetooth and voice commands opens up opportunities for various applications. Users could remotely operate the car for tasks like surveillance, delivery, or exploration in hazardous environments.

5. Education and Research: Voice and Bluetooth-controlled robot cars can serve as educational tools for teaching programming, robotics, and AI concepts to students of all ages. T hey can also be used in research projects for experimenting with new algorithms and technologies in robotics and AI.

6. Entertainment and Gaming: Robot cars controlled via voice and Bluetooth can be used for entertainment purposes, such as racing games or interactive experiences. They could also serve as platforms for augmented reality (AR) games and experiences.

7. Commercial and Industrial Applications: In industries like warehousing, manufacturing, and logistics, voice and Bluetooth-controlled robot cars can streamline processes such as inventory management, material handling, and transportation.

8. Healthcare and Assistance: In healthcare settings, robot cars can assist patients with mobility issues or act as delivery vehicles within hospitals. Voice control can make them more accessible to users with disabilities.

9. Environmental Monitoring and Exploration: Equipping robot cars with sensors and cameras for environmental monitoring or exploration tasks, such as surveying terrain or inspecting infrastructure, can be facilitated by voice and Bluetooth control for remote operation.

10. Customization and Personalization: Providing users with the ability to customize and personalize their robot cars through voice commands and Bluetooth connections can enhance the user experience and foster a deeper sense of ownership.

Overall, the future for voice and Bluetooth-controlled robot cars is promising, with numerous opportunities for innovation and application across various domains. As technology advances and user needs evolve, we can expect to see continued growth and development in this field.

REFERENCES

[1] D. Floreano and J. Urzelai, "Evolutionary Robots with Online Self-Organization and Behavioral Fitness," June 2000.M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

[2] Zhizeng L, Jingbing Z, "Speech recognition and its application in voice-based robot control system," In 2004 International Conference on Intelligent Mechatronics and Automation, 2004. Proceedings.

[3] Ryther CA, Madsen OB, "Obstacle Detection and Avoidance for Mobile Robots," Technical University of Denmark, 2009.

[4] Dhanya KR, JeyanthiR, "Automatic braking system with fusion concept," Int. J. Emerg. Trends Eng. Dev., April 2012.

[5] Ahasan MA, Hossain SA, Siddiquee AU, Rahman MM (2012). Obstacles Invariant Navigation of an Autonomous Robot Based on GPS. Khulna University.

[6] Ass. Prof. Emad S. Othman, Senior Member IEEE - Region 8, 2017, Voice Controlled Personal

[7] Harshada Rajput, Karuna Sawant, Dipika Shetty, Punit Shukla, Prof. Amit Chougule, 2018, Engineering and Technology (IRJET), pp1154-1156.

[8] T. Thivagar, A. Sriram,2020, Hand Gesture ,2020, Voice Controlled Smart Vehicle, International

[9] http://science.howstuffworks.com/robot2.htm

[10] http://en.wikipedia.org/wiki/Robotics

[11] https://www.arduino.cc

[12] http://en.wikipedia.org/wiki/Artificial_intelligence