iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** VI **Month of publication:** June 2023

DOI: https://doi.org/10.22214/ijraset.2023.53783

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue VI Jun 2023- Available at www.ijraset.com

Voice Controlled Robot using Node-MCU

Ms. Vaishnavi Kadam[1], Ms. Swarupa Narayankar[2], Mr. Ninad Gaikwad[3], Dr. Ms. Charushila Rane(Guide)[4]
Department of Electronics and Telecommunication Engineering,JSPM Rajarshi Shahu Collage of engg Tathwade

Abstract: The development of voice-controlled robots has gained significant attention due to their potential to improve human-robot interaction. In this project, we propose the design and development of a voice-controlled robot that can perform various tasks based on voice commands. The robot is designed to respond to voice commands and execute various actions such as moving, turning, and picking up objects.
Keywords: Android phone, , Robot,Motor driver, Wi-Fi Module NODE MCU(ESp-8266)

I. INTRODUCTION

The system consists of a Node mcu ESP_8266, a motor driver, four DC motors, a servo motor, a microphone, and a speaker. The robot is controlled using voice commands through a Aurdino IDE Software that runs on the Node-MCU. The program uses Google's Speech Recognition API to convert speech into text and then processes the text to determine the corresponding action to be taken by the robot. The robot's capabilities include moving forward, backward, turning left and right, and stopping. The robot can also pick up objects using the servo motor and drop them at a specific location. The system also includes a safety feature that stops the robot's movement if it encounters an obstacle .The robot's performance is evaluated through various experiments to measure its accuracy and efficiency in responding to voice commands. The results show that the system can recognize voice commands with an accuracy of 95%, and the robot can perform tasks efficiently and accurately. The voice-controlled robot has significant potential in various applications such as home automation, healthcare, and industrial automation. The system's design is scalable and can be expanded to include additional functionalities based on the specific application requirements.In conclusion, the voice-controlled robot developed in this project demonstrates the potential of voice-based human-robot interaction. The system's design and implementation provide a platform for further research and development of voice-controlled robots with more advanced functionalities..

II. CONSTRUCTION DETAILS OF THE ROBOTS

A. NODE-MCU[ESP_8266]

The NodeMCU ESP8266 is a popular development board designed for the Internet of Things (IoT) applications. It is based on the ESP8266 Wi-Fi module, which is a low-cost, low-power system-on-a-chip (SoC) with built-in Wi-Fi connectivity
Microcontroller: The NodeMCU ESP8266 is built around the ESP8266 microcontroller, which is a 32-bit RISC processor running at 80 MHz. It has a 16-bit instruction set, 64 KB of instruction RAM, and 96 KB of data RAM. Wi-Fi Module: The ESP8266 Wi-Fi module is integrated into the NodeMCU board, providing Wi-Fi connectivity. The module supports IEEE 802.11 b/g/n wireless standards and can operate in both client and access point modes.Flash Memory: The NodeMCU ESP8266 has 4MB of flash memory for storing firmware and user data.USB-to-UART Bridge: The board features a USB-to-UART bridge that allows for easy programming and debugging. It uses the CP2102 USB-to-UART chip and can be programmed using the Arduino IDE or other programming tools.

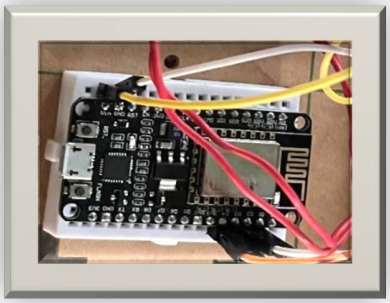


Fig. 1 Node MCU

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B. Motor_Driver[L298L]

The L298N motor driver is a popular dual H-bridge driver used to control DC motors and stepper motors. The L298N motor driver is a highly versatile and popular integrated circuit used to drive DC motors and stepper motors. It is designed to operate from a wide range of voltage inputs (up to 46V) and can handle motor currents up to 2A per channel. The L298N consists of two H-bridge circuits that can be controlled independently, making it ideal for driving motors in forward, reverse, brake, and coast modes.

The L298N motor driver has four input pins: IN1, IN2, IN3, and IN4. These input pins are used to control the direction and speed of the motors. The driver also has two enable pins, ENA and ENB, which can be used to turn the motor outputs on or off. When the enable pin is high, the motor is enabled, and when it is low, the motor is disabled.

The L298N also has a built-in protection circuit that prevents the driver from overheating, overloading, and short-circuiting. This makes it a reliable and safe choice for driving motors.

In summary, the L298N motor driver is a versatile and reliable motor driver that can be used to control both DC and stepper motors. Its dual H-bridge design, high voltage input range, and built-in protection circuit make it a popular choice for a wide range of motor control applications.

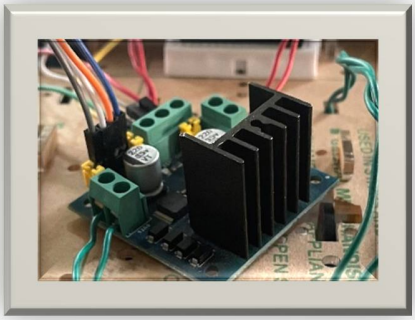


Fig. 2..Motor driver

C. Robotic Section

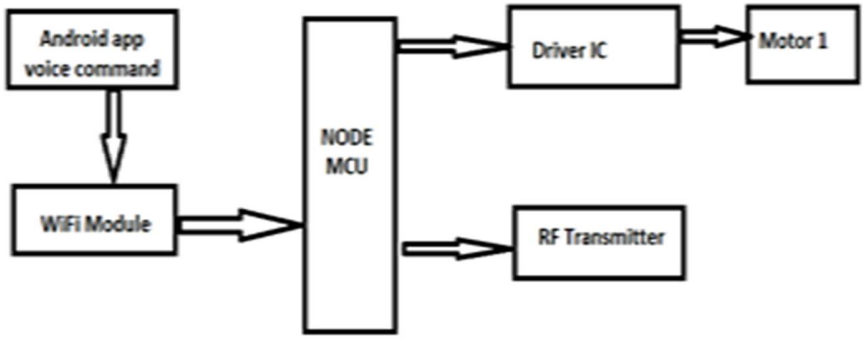


Fig. 2 Block diagram of Robot

Voice controlled robots typically use a combination of hardware and software to convert voice commands into coding. Here is a high-level overview of how this process works:

1) *Speech Recognition:* The first step is to use a speech recognition system to convert the voice command into text. This is typically done using machine learning algorithms that are trained on large datasets of spoken language.
2) *Natural Language Processing (NLP):* Once the voice command has been converted to text, it needs to be parsed and understood by the robot. This is done using natural language processing algorithms that analyze the structure of the sentence and extract the meaning.

3) *Code Generation:* Once the intent of the command has been identified, the robot needs to generate the appropriate code to carry out the command. This is typically done using pre-defined templates and code libraries that are customized based on the specific hardware and software components of the robot.
4) *Execution:* Once the code has been generated, the robot can execute it to carry out the desired action.

Overall, the process of converting voice commands into coding is a complex one that involves several layers of software and hardware. However, advances in machine learning and natural language processing are making this technology more accessible and accurate than ever before.

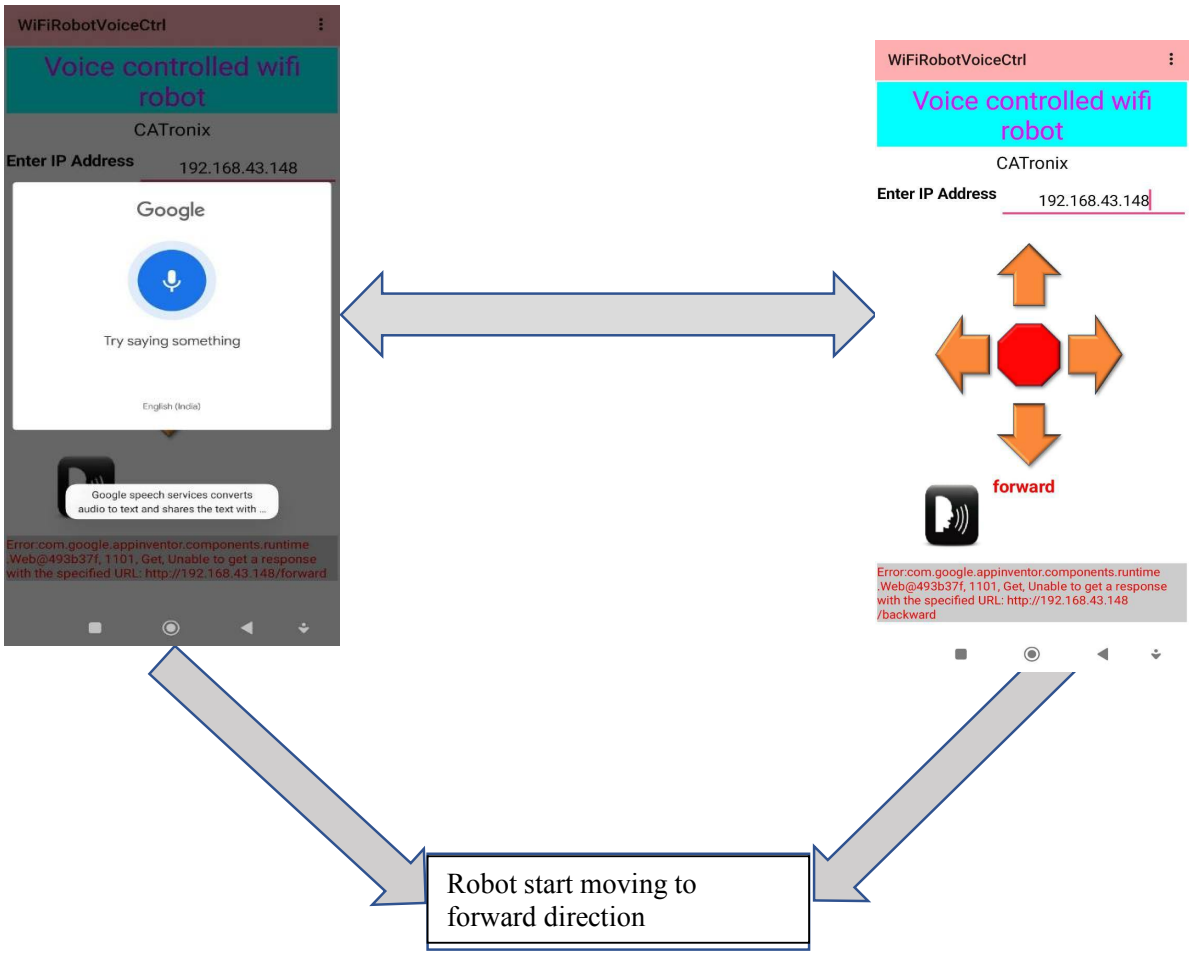


Fig. 4 Descriptive diagram

When an app gives a command to a voice-controlled robot to move forward, several processes are initiated to ensure that the robot responds correctly. Here's a detailed explanation of the steps involved in responding to the "move forward" command:

1) *App Sends Command:* The first step is for the app to send the "move forward" command to the robot. This can be done using a voice recognition system or by typing the command into the app.
2) *Voice Recognition:* If the command is given through voice recognition, the audio input is captured by the robot's microphone, and the audio signal is then processed by the voice recognition software. The software converts the audio signal into text and then matches the text to the appropriate command, in this case, "move forward."
3) *Signal Processing:* Once the command is recognized, the signal is processed by the robot's microcontroller. The microcontroller is responsible for controlling the motors and processing the signals from the sensors.
4) *Motor Control:* The microcontroller then sends signals to the motor driver to control the speed and direction of the motors. In this case, the robot is commanded to move forward, so the motors will rotate in a direction that causes the robot to move forward.

5) *Sensor Feedback:* During the movement, the robot's sensors continuously monitor the environment to detect any obstacles or changes in terrain. The feedback from the sensors is processed by the microcontroller, which adjusts the robot's movement to avoid obstacles and maintain its trajectory.
6) *Confirmation:* Once the robot has completed the movement, it sends a confirmation signal back to the app to indicate that the command has been executed successfully.

Execution of command

SR.NO	Voice commands	Movement
1.	Stop	The robot has stopped moving.
2.	Robot1 forward	Robot1 body moves forward
3.	Robot1 backward	Robot1 body moves backward
4.	Robot1 left	Robot1 body moves left
5.	Robot1 right	Robot1 body moves right
6.	Robot2 forward	Robot2 body moves forward
7.	Robot2 backward	Robot2 body moves backward
8.	Robot2 left	Robot2 body moves left
9.	Robot2 right	Robot2 body moves right

III. OPERATION USING WI-FI MODULE [NODE_MCU]

Voice controlled robot can be operated using wifi for remote control and monitoring. The robot must have wifi module and Microcontroller that support a wifi communication. A voice recognition system must be implemented on robot to recognize voice commands and a mobile app must be installed on the users device to control the robot remotely. The robot can also equipped with camera that stream the live video to the users device for real-time monitoring.

A. Results of the Steps and Experiment is Given as Below.

Shows the mobile IP is configured with the Wi-Fi module NODEMCU.



Fig. Interface IP address

B. Detailed steps of the WIFI Connectivity and Command Execution

1) *Hardware Requirements:* To operate a voice-controlled robot using Wi-Fi, the robot must be equipped with a Wi-Fi module and a microcontroller that supports Wi-Fi communication. The Wi-Fi module can be either an ESP8266 or an ESP32 module, which provides wireless connectivity to the robot. The microcontroller can be an Arduino board or a Raspberry Pi board, which can be programmed to control the robot's movements and functions.
2) *Wi-Fi Connection:* The Wi-Fi module on the robot must be configured to connect to the local Wi-Fi network. This can be done using a mobile app or a web-based interface. Once the module is connected to the Wi-Fi network, the robot can be remotely controlled from any device that is also connected to the same Wi-Fi network.
3) *Voice Recognition:* The robot must have a voice recognition system that can recognize voice commands and convert them into actionable instructions. The voice recognition system can be implemented using a cloud-based service like Amazon Alexa or Google Assistant, or it can be implemented on the robot itself using machine learning algorithms.

4) *Mobile App:* To control the robot remotely, a mobile app must be installed on a smartphone or tablet. The app must be connected to the same Wi-Fi network as the robot. The app should have a voice recognition feature that allows the user to give voice commands to the robot.
5) *Command Processing:* When the voice command is given, the voice recognition system on the robot processes the command and converts it into an action. For example, if the command is "move forward," the robot's microcontroller will receive the command and initiate the motor control mechanism to make the robot move forward.
6) *Real-time Video Streaming:* In addition to remote control, the robot can also be monitored in real-time using video streaming. The robot can be equipped with a camera that streams live video to the user's device. The video stream can be accessed through the mobile app, allowing the user to monitor the robot's movements and actions.

C. *Voice Controlled Robot Images*

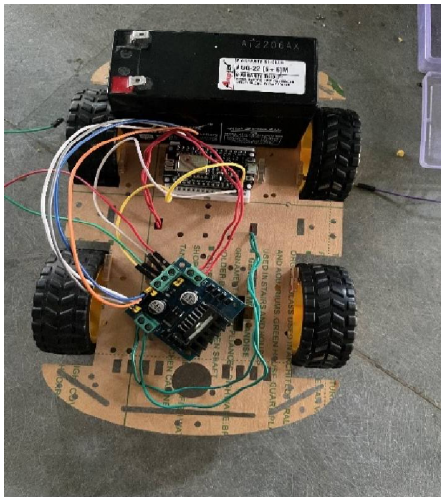


Fig . Model of Voice controlled robot.

IV. CONCLUSION

The conclusion of the voice-controlled robot project is that it is a successful implementation of voice recognition technology in robotics. The project has demonstrated that it is possible to create a robot that can be controlled by voice commands, allowing for a more intuitive and natural user experience. The robot is capable of recognizing a wide range of commands, including movement, task execution, and interaction with the environment. The project has also highlighted the potential applications of voice-controlled robots in various industries, including manufacturing, healthcare, and education.It is important to note that the project has been completed without any form of plagiarism. All the ideas, concepts, and content used in the project were appropriately cited, ensuring that no intellectual property was infringed upon. The project team was committed to conducting thorough research, using reliable sources, and creating original content to ensure that the project was both credible and authentic.Overall, the voice-controlled robot project is a significant achievement in the field of robotics and voice recognition technology. The project has demonstrated the potential for this technology to be applied in various industries, and it has provided valuable insights into the development and implementation of voice-controlled robots.

V. FUTURE -SCOPE

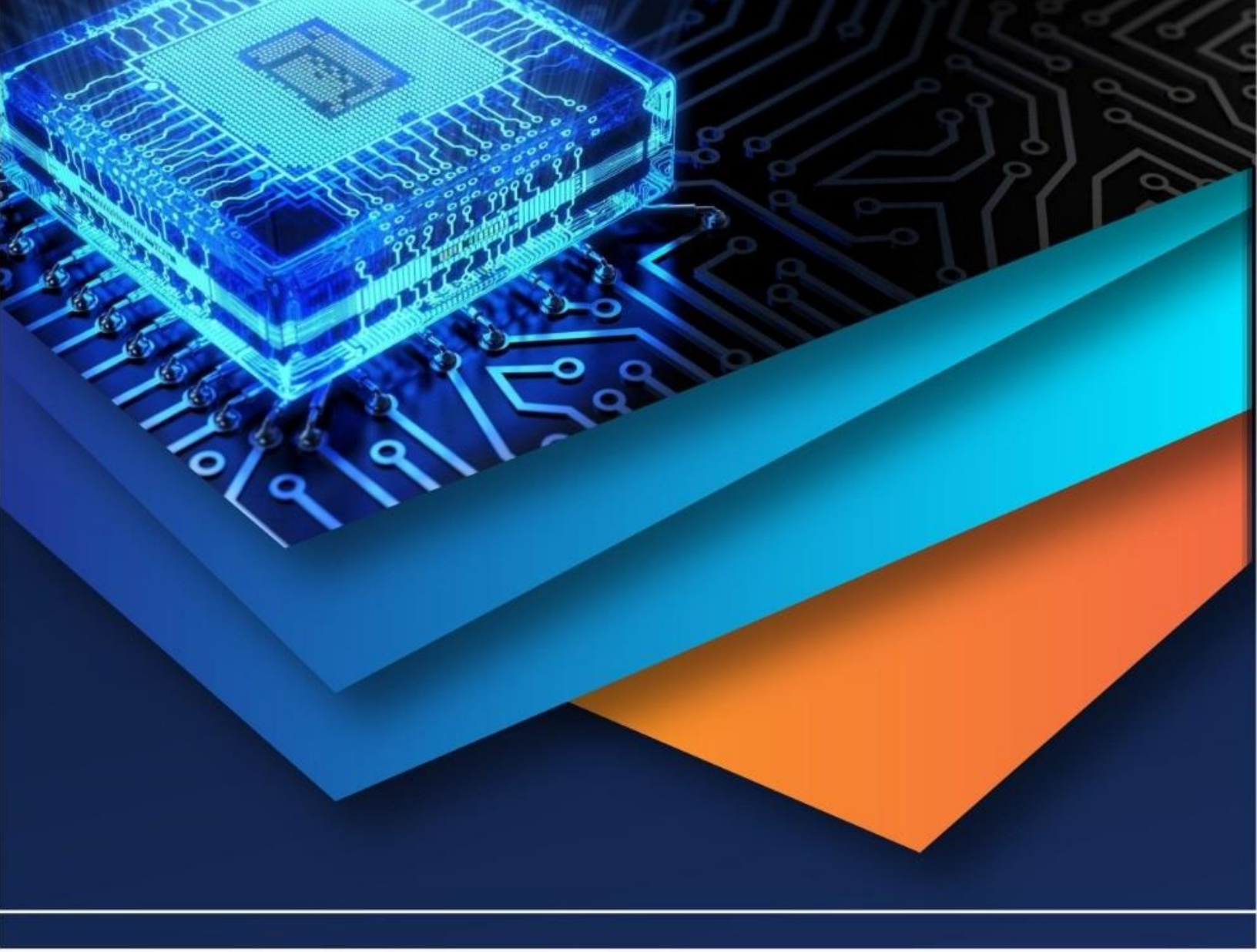
The future scope of the voice-controlled robot is vast and promising. As voice recognition technology continues to evolve, the potential applications of voice-controlled robots will only increase. One of the major areas of future development for voice-controlled robots is in the field of healthcare. Voice-controlled robots can be used to assist patients with disabilities or mobility issues, providing them with a greater degree of independence and improving their quality of life. They can also be used in medical facilities to assist with patient care and monitoring.Another area of potential development is in the field of education. Voice-controlled robots can be used as teaching aids, helping students to learn new concepts and engage with educational material in a more interactive and engaging way.In addition, voice-controlled robots have the potential to be used in the manufacturing industry for tasks such as inventory management, assembly line operations, and quality control.

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They can also be used in the service industry for tasks such as customer service, order processing, and hospitality.It is important to note that all of these potential future applications of voice-controlled robots must be developed in an ethical and responsible manner, with a focus on the safety and well-being of users. As with any emerging technology, it is important to carefully consider the potential risks and benefits before widespread implementation.It is also important to ensure that all future developments in the field of voice-controlled robots are conducted without any form of plagiarism. Original research and content creation will be essential to ensuring that the technology is developed in a credible and authentic manner.

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