Hand Gesture Controlled Car Using Arduino

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Abstract*— This paper presents the development of a Hand Gesture Controller Robot Car using Arduino. The proposed system aims to control a robot car's movement by interpreting hand gestures through an Arduino board. The hand gesture controller consists of a flex sensor and an accelerometer to capture the hand's movements accurately. The Arduino board processes the data from the hand gesture controller and sends the commands to the robot car's motors. The experimental results show that the proposed system can effectively control the robot car's movement with hand gestures. The Hand Gesture Controller Robot Car has the potential to be used in various applications such as surveillance, exploration, and rescue missions. A hand gesture-controlled car is a robotic vehicle that can be directed to move forward, backward, left, or right based on specific hand gestures. Unlike traditional remote-controlled cars that use joysticks or buttons, this car uses sensors to detect the orientation and movement of a hand to determine its direction. An accelerometer, attached to the hand, detects the tilt or position, translating these movements into commands that are sent wirelessly to the car. This innovative design allows for a hands-free, intuitive way to control the car's motion.

Keywords —Robotic vehicle, Remote Controlled car, Hand Gesture, Controller, Robot Car, Arduino, Accelerometer, Wireless Communication, Motors, Movement Control, Orientation and movement.

I. INTRODUCTION

Human-robot interaction has been a popular research topic due to its potential for applications in various fields such as industrial automation, healthcare, and entertainment. Among the many interaction methods, hand gesture control has gained significant attention due to its natural and intuitive nature. In this research paper, we present the design and implementation of a Hand Gesture Controller Robot Car using Arduino, which enables users to control the movement of a robot car through hand gestures.

1.1 SYSTEM OVERVIEW

The proposed system employs an ultrasonic sensor to detect obstacles and a Bluetooth module for wireless communication between the robot car and the hand gesture controller. The hand gesture controller comprises a flex sensor and an accelerometer to accurately capture hand movements. An Arduino board is used to process the data from the hand gesture controller and send commands to the robot car's motors.

II.MAIN COMPONENTS

1.ADXL335 Accelerometer: The ADXL335 accelerometer is a three- axis accelerometer that measures the acceleration and tilt of the device. In the Hand Gesture Controller Robot Car, the accelerometer is used to detect the orientation of the hand and send the corresponding signals to the Arduino Nano.

2.Arduino Nano: The Arduino Nano is a compact and low-cost microcontroller board that is programmed to receive signals from the accelerometer, process them, and send them wirelessly to the Receiver Section. The Arduino Nano used in this project has an onboard RF module for wireless communication.

3.RF Module: The RF module is used to transmit the hand gesture signals wirelessly to the Receiver Section. The RF module used in this project is the NRF24L01 Module.

4.Motor Driver: The motor driver is a device that controls the speed and direction of the motors. In the Hand Gesture Controller Robot Car, the motor driver is used to control the movement of the robot car based on the hand gesture signals received from the Transmitter Section.

5.Robot Car Chassis: The robot car chassis is the physical body of the robot car, which includes the motors, wheels, and

other mechanical components. The robot car chassis used in this project is a 4-wheel drive chassis with two DC motors for driving the rear wheels and two servo motors for steering the front wheels.

III. PROPOSED SYSTEM

The proposed Hand Gesture Controller Robot Car using Arduino aims to offer a user-friendly and natural method for controlling robot cars through hand gestures. The proposed system combines the use of sensors, wireless communication, and Arduino programming for hand gesture recognition and robot control.

Here are the key features of the proposed system:

1. Hand Gesture Controller: The hand gesture controller consists of a flex sensor and an accelerometer to capture hand movements. The flex sensor is used to detect finger movements, while the accelerometer detects hand orientation.
2. Wireless Communication: The hand gesture data is transmitted to the robot car via Bluetooth, which allows for wireless control of the robot car.
3. Robot Car: The robot car is equipped with an ultrasonic sensor to detect obstacles and an Arduino board for processing the data and sending commands to the motors.
4. Arduino Programming: The Arduino board is programmed to receive the hand gesture data, process it, and send commands to the motors to control the robot car's movement.
5. Gesture Recognition Algorithm: The proposed system uses a gesture recognition algorithm to recognize different hand gestures and translate them into specific commands for the Robot car.

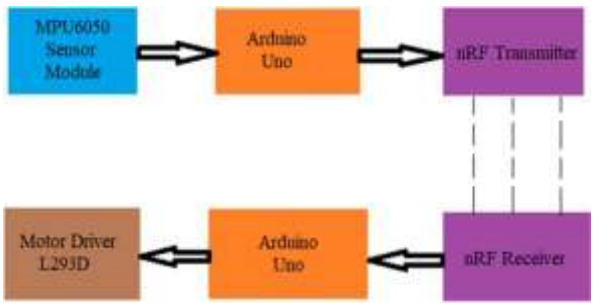

FIG. 1 LAYOUT OF SYSTEM

IV. METHODOLOGY

Assemble the Robot Car Chassis: The first step is to assemble the robot car chassis. This involves attaching the motors, wheels, and other mechanical components to the chassis. The robot car chassis used in this project is a 4-wheel drive chassis with two DC motors for driving the rear wheels and two servo motors for steering the front wheels.

Install the Ultrasonic Sensor: The ultrasonic sensor is used to detect obstacles in front of the robot car and send signals to the Arduino Nano for obstacle avoidance. Install the ultrasonic sensor on the front of the robot car chassis.

Connect the Motor Driver: The motor driver is used to control the speed and direction of the motors. Connect the motor driver to the motors and the Arduino Nano.

Connect the RF Module: The RF module is used to transmit the hand gesture signals wirelessly to the Receiver Section. Connect the RF module to the Arduino Nano.

Connect the ADXL335 Accelerometer: The ADXL335 accelerometer is used to detect the orientation of the hand and send corresponding signals to the Arduino Nano. Connect the ADXL335 accelerometer to the Arduino Nano.

Hardware Setup

Install Arduino IDE: The Arduino IDE is used to program the Arduino Nano. Download and install the latest version of the Arduino IDE.

Install the Required Libraries: The project requires several libraries, including the RF24, Servo, and New Ping libraries. Install these libraries in the Arduino IDE.

Upload the Transmitter Code: Upload the transmitter code to the Arduino Nano in the Transmitter Section. The code reads the signals from the ADXL335 accelerometer and sends them wirelessly to the Receiver Section.

Upload the Receiver Code: Upload the receiver code to the Arduino Nano in the Receiver Section. The code receives the hand gesture signals from the Transmitter Section, processes them, and controls the movement of the robot car accordingly.

V. WORKING

There are five hand gestures which can be recognized by the car. They are STOP, RIGHT, LEFT, BACKWARD, FORWARD.

The following are the hand gestures used in controlling the car.

A) The Fig.2 specifically illustrates the gesture for moving **left**, which involves extending an arm horizontally with the palm facing downward. This gesture is interpreted by the system to command the car to turn left.

Fig.2 Gesture to move left

B) The Fig.3 represents a hand gesture used for controlling a car, specifically to move it **backward**. The gesture involves extending the palm outward with fingers pointing forward,

signaling the system to reverse the car.

Fig.3 Gesture to move backward

C) The Fig.4 shows a hand gesture with the palm facing left and fingers extended, labeled "**Right**," indicating a command for a hand gesture-controlled car to turn right. The system recognizes this gesture to steer the vehicle in the desired direction.

Fig.4 Gesture to move right

D) The Fig.5 shows a hand gesture with the palm facing downward and fingers extended, labeled "**Stop**," indicating a command for a hand gesture-controlled car to halt. The system detects this gesture to stop the vehicle immediately.

Fig.5 Gesture to move stop

E) The Fig.6 shows a hand gesture with the palm facing downward and fingers slightly curved, labeled "**Forward**," indicating a command for a hand gesture-controlled car to move ahead. The system interprets this gesture to drive the vehicle forward.

Fig.6 Gesture to move forward

VI.TESTING AND CALIBRATION

Test the Ultrasonic Sensor: Test the ultrasonic sensor by placing obstacles in front of the robot car and ensuring that it detects them and sends signals to the Arduino Nano for obstacle avoidance.

Test the Hand Gesture Control: Test the hand gesture control by performing various hand gestures and ensuring that the robot car responds accordingly.

Calibrate the ADXL335 Accelerometer: Calibrate the ADXL335 accelerometer by ensuring that it accurately detects the orientation of the hand and sends corresponding

signals to the Arduino Nano.

Adjust Motor Speed and Steering: Adjust the motor speed and steering of the robot car to ensure that it moves smoothly and accurately in response to the hand gesture signals.

VII. APPLICATION

1. Education: The Hand Gesture Controller Robot Car can be used as a learning tool for students to explore the concept of robotics and control systems.
2. Entertainment: The system can be used as a fun and interactive toy or game for individuals to control the movement of a robot car using hand gestures.
3. Accessibility: The hands-free and easy-to- use nature of the system can be beneficial for individuals with physical disabilities or limited mobility, allowing them to control the robot car without the need for physical buttons or controls.

VIII. ACTUAL VIEW OF THE PROJECT

Fig 7 shows the transmitter part. Transmitter part send the signal to the receiver part. The components include an MPU6050 accelerometer-gyroscope module, an NodeMCU microcontroller, and a motor driver, which work together to interpret hand movements and control the car accordingly.

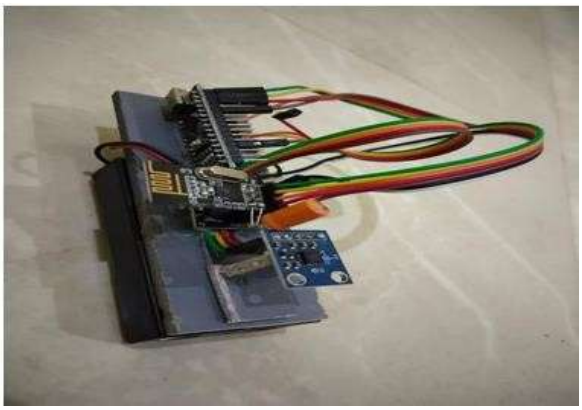

Fig.7 TRANSMITTER PART

Fig. 8 shows the receiver part. Receiver part receive the signal from transmitter part. It consists of a microcontroller , a motor driver module, and four wheels powered by DC motors. A separate gesture-sensing module detects hand movements and wirelessly transmits signals to the car. The car processes these signals and moves forward, backward, left, or right accordingly. A rechargeable battery powers the system, making it a wireless and intuitive control solution.

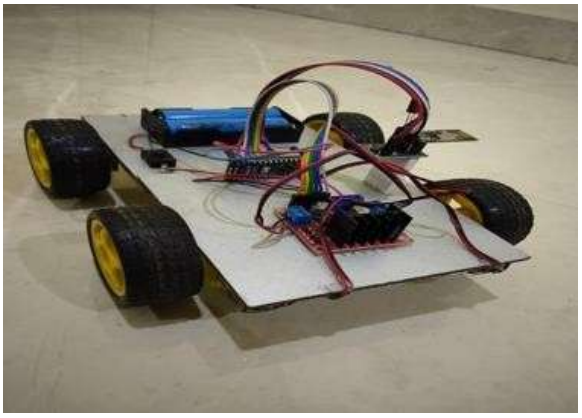

Fig.8 RECEIVER PART

IX. CONCLUSION

In conclusion, the Hand Gesture Controller Robot Car using Arduino Nano provides an innovative and convenient way to control the movement of a robot car using hand gestures. The system is easy to use, wireless, and accessible, making it suitable for various applications such as education, entertainment, and accessibility. However, the system may have limitations such as limited range, limited hand gesture options, and the need for calibration. Despite these limitations, the system has demonstrated the potential for hands-free and intuitive control of robotic devices. Future research can further explore the capabilities and limitations of the system and potential improvements to enhance its performance and usability.

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