Hand Gesture Control Robot car

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***Abstract*— A hand gesture controlled robot car using Arduino is a wireless robot car that uses hand gestures to move, without the need for buttons or a joystick. The robot has two main parts: a transmitter and a receiver. The transmitter uses an accelerometer to detect hand gestures and send them to the receiver section. The receiver section has an Arduino that reads the data and controls the robot's movement using DC motors. Through L298n motor driver. Direction of the car can be changed by moving the hand in a particular direction all movement generates the values in its corresponding axis.An accelerometer is a sensor that detects changes in motion, orientation, and acceleration. In hand gesture-controlled robot car. An accelerometer (e.g., MPU6050) is used to track the movement of the user's hand and convert it into control signals for the robot car. HC05 Bluetooth module connected both side receiver section and transmitter section that paired for ready gesture control car. Additionally, the robot includes a charging module for efficient power management, ensuring uninterrupted operation.**

Keywords: **Arduino UNO, Bluetooth module Arduino nano, Accelerometer, motor driver dc motor Communication, charging module Motors, Movement Control.**

I. INTRODUCTION

The rapid advancement of technology has paved the way for innovative human-machine interaction methods. One such breakthrough is the development of hand gesture controlled robotic systems, which enable intuitive and touch-free control. This research focus on the design and implement of a hand gesture-controlled robotic car using arduino. Traditional robotic control methods on wireless controllers, requiring physical contact or button-based interfaces. However gesture based control offers a more natural and user-friendly alternative, especially in applications where hands-free operation is advantageous, such as assistive technology, surveillance, and automation.

The proposed system utilizes accelerometer and gyroscope sensors (such as the MPU6050) to capture hand movements, which are then processed and transmitted wirelessly to the robotic car using RF or Bluetooth modules. The arduino microcontroller interprets these signals to control the movement of the vehicle (forward, backward, left, and right).

This research focuses on developing a hand gesture-controlled robotic car using arduino, with an additional feature of an integrated charging module to enhance its efficiency and usability. To enhance the practicality and autonomy of the system, a charging module is integrated, ensuring continuous operation without manual charging. The module may include wired charging where the car can charge when the battery is low. This feature significantly improves the usability of the system, making it more efficient for long-term application.

II. LITERATURE REVIEW

1. This hand gesture control robot car Connect and Communicate with physical devices through transmitter section and receiver section.

2. The primary objective of this research is to design and develop a wireless robotic car controlled through hand gesture using an accelerometer sensor and arduino microcontroller. The system aims to provide an efficient, user-friendly, and cost-effective solution for remote vehicle control by interpreting hand movements into directional commands. Additionally, the integration of a charging module seeks to enhance the operational sustainability of the robot by ensuring uninterrupted power supply through efficientuse two 18650 lithium li-ion battery holder in which battery that connects with arduino Uno board.

3. This innovation focuses on creating a highly responsive, accurate, and user-friendly system that translates real time hand movements into

smooth, precise vehicle control. By incorporating advanced features such as efficient wireless communication and an optimized power management system with a charging module.

4. Convenience: implement a convenient and user friendly hand gesture controlled robotic car using arduino and an accelerometer sensor. This project aim to the control process by allowing users to operate the car effortlessly through natural hand movements. This will bring efficiency along with comfort and convenience.

III. COMPONENTS DETAIL

A. Arduino UNO:

The Arduino Uno is one of the most popular and widely used microcontrollers in the Arduino family. It is an open-source platform used for building a variety of electronics projects, including robotics, home automation, and interactive devices. Here are the key details about the (AU).

B. MPU6050

THE MPU6050 is a 6-axis motion tracking device that combines a 3-axis accelerometer and a 3-axis gyroscope in a single chip. It is commonly used in robotics, drones, and other motion-sensing applications.

C. Arduino Nano

The arduino nano is an open-source microcontroller board based on the microchip ATmega328P microcontroller and developed by arduino and initially released in 2008. It offers the same connectivity and specs of the arduino uno board in a smaller form factor.

D. TWO HC-05 BLUETOOTH MODULES :

It is used for many applications like wireless headset, game controllers, wireless mouse, wireless keyboard, and many more consumer applications.
It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions.

It is IEEE 802.15.1 standardized protocol, through which one can build wireless Personal Area Network (PAN). It uses frequency-hopping spread spectrum (FHSS) radio technology to send data over air.

It uses serial communication to communicate with devices. It communicates with microcontroller using serial port (USART).
It has 6 pins,

1. Key/EN: It is used to bring Bluetooth module in AT commands mode. If Key/EN pin is set to high, then this module will work in command mode. Otherwise by default it is in data mode. The default baud rate of HC-05 in command mode is 38400bps and 9600 in data mode.

HC-05 module has two modes,

1. Data mode: Exchange of data between devices.
2. Command mode: It uses AT commands which are used to change setting of HC-05. To send these commands to module serial (USART) port is used.
2. VCC: Connect 5 V or 3.3 V to this Pin.
3. GND: Ground Pin of module.
4. TXD: Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)
5. RXD: Receive data serially (received data will be transmitted wirelessly by Bluetooth module).
6. State: It tells whether module is connected or not.

E. 4 WHEEL CHASSIS KIT WITH DC MOTORS:

We use 4 wheel and chassis kit and add with dc motors and all module.

F. L298 Driver:

The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time. The module can drive DC motors that have voltages between 5 and 35V, with a peak current up to 2A.
There are 4 input and 4 output pin.
Inp1 and inp2 motor a used to control the spinning direction. Of motor a.
Inp3 and inp4 motor b used tocontrol the spinning direction. Of motor b.
Enable(a)- enables pwm signal for motor a
Enable(b)- enables pwm signal for motor b
Out1 & out2 – outpin for motor a.
Out3 & out4 – outpin for motor b.

G. Four 18650 LI-ION rechargeable battery:

These are attached to the wheels of the car to give them power to move.

IV. IMPLEMENTATION

A. Circuit Connections of receiver section

- The receiver section is responsible for capturing the gesture signals transmitted wirelessly from the hand gesture module, decoding them, and converting them into physical movement commands for the robot car. This section acts as the brain of the system and is built around the arduino microcontroller.

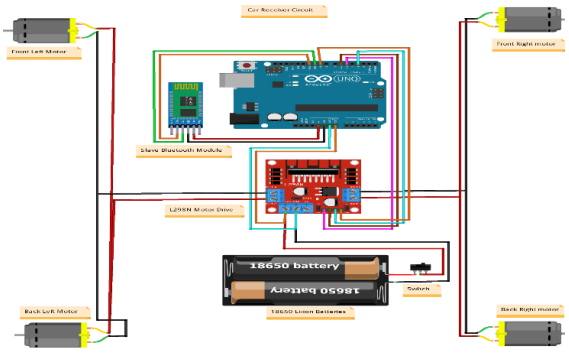

Figure 1 Hand Gestured Controlled Car receiver circuit

B. Circuit Connections of transmitter section

In the transmitter section we have include arduino nano, master Bluetooth module, mpu6050 accelerometer, and battery for power.

When we open the switch robot car detect the gesture through Bluetooth module they send the signals accelerometer for robot car and receiver the signal from receiver section.

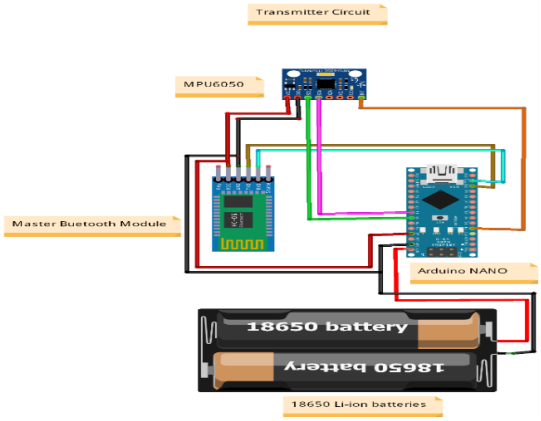

Figure 2 Circuit Diagram of Transmitter

B. Working

- We are working in hand gesture control robot car in five type which can be recognized be car. We are RIGHT, LEFT, FORWARD, BACKWARD, AND STOP.

GESTURE DETECTION (TRANSMITTER SIDE):

The accelerometer (mpu6050) detects the till and movement of your hand in different directions (forward, backward, left,right).The sensor data (X, Y, Z axis) is read by the arduino. Arduino processes this data to identify specific gestures.Based on the gesture, it assigns a direction command (Like F, B, L, R, S).

WIRELESS TRANSMISSION:

The command is sent via Bluetooth module (hc-05) to the receiver on the robot car.

ROBOT CAR (RECEIVER SIDE):

The receiver arduino receives the signal. It decodes the command and sends signals to the motor driver (l298n).The motor driver controls the movement of the dc motors accordingly.

V. FURURE SCOPE

The future scope of a hand gesture controlled robot car using arduino is quite promising especially as gesture recognition becomes more accurate and widely adopted. Here are some key points.

1. Advanced assistive technology
2. Smart home and IOT integration
3. Industrial applications
4. Educational and research tool
5. Gaming and entertainment
6. Military and defence

VI. CONCLUSION

The hand gesture controlled robot car using arduino and a charge module is an innovative and interactive project that demonstrates the integration of gesture recognition, wireless communications. By using an accelerometer (such as the MPU6050) or a gyroscope-based sensor, hand movements are converted into signals that control the motion of the robot. The arduino processes these signals and sends commands to the motor driver, enabling the robot car to move forward, backward, left, or right.

The inclusion of a charge module ensures that the robot operates efficiently without frequent battery replacements, making it more practical for extended use. This project enhances understanding of microcontrollers, wireless transmission (such as RF or Bluetooth), and motor control, which are fundamental concepts in robotics and automation.

Overall this project is a great way to explore gesture based control system and can be further improved by integrating AI obstacle avoidance, or advanced wireless communication modules.

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