Gesture Based Driven Gyroscopic Model Using Arduino

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***Abstract* - A gesture-controlled car is a robotic system that operates based on hand movements using an accelerometer sensor mounted on a glove. The sensor detects the direction and orientation of the hand and transmits signals wirelessly via radio waves to control the car's movement. This allows the user to move the car forward, backward, left, and right, as well as control its speed, without using a traditional remote. The system uses a differential drive mechanism, enabling sharp turns and rotation in place by controlling wheel directions. Additionally, a gesture-controlled robotic arm using flex sensors can be integrated to mimic human hand movements, enhancing the system's functionality. This project provides an intuitive, wireless, and user-friendly approach to controlling robotic systems, with applications in automation, assistive technologies, and robotics.**

I. INTRODUCTION

Nowadays, robotics has become one of the most advanced and rapidly growing fields in technology. A robot is an electro-mechanical system that operates using a computer program and can perform tasks automatically. Robots can be autonomous, semi-autonomous, or manually controlled. Autonomous robots work on their own by sensing their environment, while semi-autonomous robots require some level of human interaction. Most industrial robots are autonomous because they need to work with high speed and accuracy. There are different ways to control robots, such as voice commands, touch, or motion-based systems. A gesture-controlled robot is a modern approach where the robot is operated using simple hand movements instead of traditional buttons or remotes. In this system, the user wears a small transmitting device fitted with an accelerometer sensor. This sensor detects hand movements and sends signals wirelessly to the robot. The transmitting unit converts the sensor's annlog signals into digital data using an ADC and encodes it with an encoder IC (HT12E). The data is then sent through an RF transmitter. On the receiving side, an RF receiver captures the signal, which is decoded using a decoder IC (HT12D). A microcontroller processes this data and controls the motors through a motor driver, allowing the robot to move accordingly. For better design and simplicity, the system is divided into two main modules: the transmitter and the receiver. Robotics has a wide range of applications in fields like automobiles, healthcare, construction, defence, and even firefighting, where robots can help in dangerous situations. Compared to traditional remote-controlled systems, gesture control offers a more intuitive and user-friendly way of interacting with robots. The main aim of this project is to control the movement of a robot using hand gestures with the help of an accelerometer, making the system more natural and efficient.

II. LITERATURE REVIEW

Moniruzzaman Bhuiyan and Rich Picking from the Centre for Applied Internet Research (CAIR), Glyndŵr University, UK, conducted an extensive review of Gesture Controlled User Interfaces (GCUI). Their study explores the development of gesture-based interaction over the past 30 years, focusing on its technology, applications, usability, and challenges. They found that GCUI offers practical and affordable solutions, especially for users who find traditional input devices difficult to use. Their research highlights how gesture-based systems can play an important role in modern and future technologies, particularly in areas like ubiquitous computing and smart environments. They also developed a prototype application called *Open Gesture*, which allows users to perform everyday tasks such as making phone calls, controlling a television, and even solving basic calculations using simple hand gestures. The study concludes that such systems can improve independence and quality of life, especially for elderly and disabled users, although some challenges still remain. In another study, Stefan Waldherr, Roseli Romero, and Sebastian Thrun introduced a gesture-based interface for controlling a mobile robot with a robotic arm. Their system uses a camera to track human

movement and recognize gestures, particularly arm motions. They implemented advanced tracking algorithms to ensure the robot can follow a person reliably, even in changing lighting conditions. The researchers compared two gesture recognition methods: a template-based approach and a neural network-based approach. Both methods were combined with the Viterbi algorithm to accurately recognize dynamic gestures. Their system was tested in a real-world scenario where a person guided the robot to clean specific areas and pick up objects. The results demonstrated that gesture-based control can be effective and practical for interactive robotic tasks.

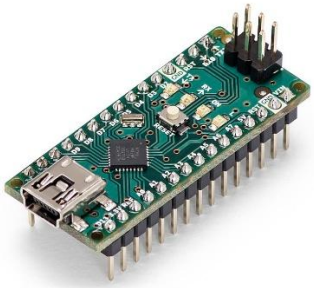
III. COMPONENTS DETAIL

1. Arduino UNO:

Arduino Uno is a popular microcontroller board based on ATmega328P. It is used to read inputs from sensors and control outputs like motors and LEDs. It has digital and analog pins for interfacing. Easy programming using Arduino IDE makes it ideal for beginners, students, and embedded system projects.

2. Arduino Nano:

Arduino Nano is a small, breadboard-friendly microcontroller board with functionality similar to Arduino Uno. It is suitable for compact and portable projects. It uses ATmega328P and supports digital and analog input/output. Its small size and low cost make it ideal for robotics and embedded system applications.

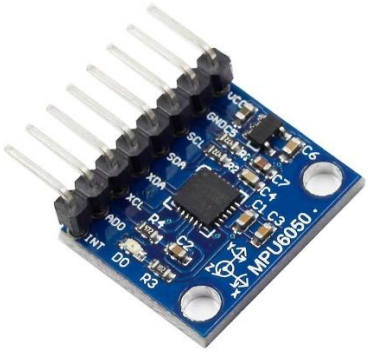


3. nRF24L01 Module:

nRF24L01 is a wireless communication module that operates in the 2.4 GHz frequency band. It enables data exchange between microcontrollers without wires. It is widely used in remote control systems, wireless sensors, and IoT applications. It supports multiple channels and consumes very low power.

4. MPU6050:

MPU6050 is a motion sensor that combines a 3-axis accelerometer and 3-axis gyroscope. It measures movement, tilt, and rotation of objects. It communicates using I2C protocol. Commonly used in drones, robots, and balancing systems, it helps detect orientation and motion accurately in real-time applications.



5. L298N Driver:

The L298N motor driver is used to control the speed and direction of DC motors. It acts as an interface between the Arduino and motors. It can drive two motors simultaneously using H-bridge circuits. It is widely used in robotics, automation, and motor control applications requiring higher current.

6. Dual Shaft DC Motor:

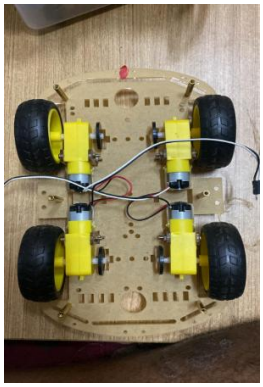
Dual shaft DC motor (300 RPM) is a geared motor providing moderate speed and good torque. It has shafts on both sides, allowing flexible mounting of

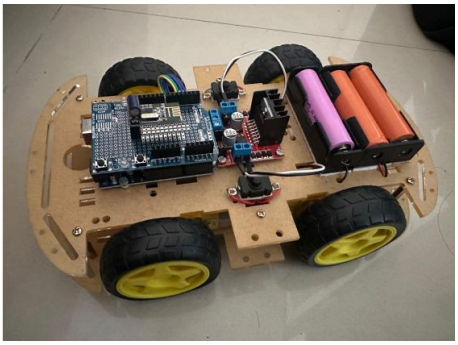
wheels or mechanisms. It is commonly used in robotic vehicles and automation systems where controlled movement and stable performance are required.

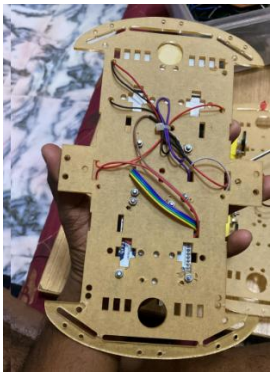
7. Lithium-ion Battery:
18650 battery is a rechargeable lithium-ion battery commonly used in electronics and robotics. It provides high energy density and stable voltage output, typically 3.7V. It is widely used to power microcontrollers, motors, and portable devices. Proper charging and protection circuits are required for safe operations.

8. Wheels:
Wheels are an important part of our project. They were connected with dc motors, the crucial interface between electronic control and physical movement. They translate the electrical signals sent by Arduino (via motor driver) into mechanical energy.

IV. ACTUAL MODEL







V. CONCLUSION

The main purpose of this project is to control a toy car using hand gestures with the help of an accelerometer sensor mounted on a glove. Instead of using a traditional remote control, the user can simply move their hand to control the car's direction and speed. The system allows movement in all directions—forward, backward, left, and right—while also adjusting the throttle based on the tilt of the hand. To implement this system, both hardware and software components were used. The hardware setup forms the robot, while the software processes the user's hand gestures. A Dell laptop with a webcam was used to capture hand movements, and the software was developed in Java using Eclipse IDE. The captured gestures were processed through image processing techniques to determine the intended direction. The identified commands were then sent wirelessly to the robot using Zigbee communication, specifically the XBee S2 module. Based on the gestures, the robot performed different actions. For example, moving the hand upward made the robot move forward, while moving it downward made it go backward. Tilting the hand to the left or right directed the robot accordingly, and keeping the

hand still stopped the robot. During testing, the system achieved around 80% accuracy. Some errors occurred due to background interference, which affected gesture detection. Despite this limitation, the project demonstrates a more natural and user-friendly way of controlling robots. It shows how hand gesture recognition can replace traditional control methods and allow users to operate devices directly through simple movements, even without additional external controllers.

VI. FUTURE SCOPE

1) Power Optimization: Replace heavy batteries with efficient power sources or use low-power motors to reduce weight and energy consumption.
2) Hazardous & Medical Use: Can be used in dangerous environments with a camera for remote operation, and in medical fields for precision tasks using small robots.
3) Gesture Control: Accuracy can be improved using threshold detection and advanced features like finger counting for multiple commands.
4) Entertainment & Automation: Useful in gaming for immersive control and in homes, offices, and vehicles to replace traditional input systems with simple gestures.

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