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HAND GESTURE CONTROLLED ROBOT

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ABSTRACT

This project proposes the development of a wired hand gesture and Bluetooth (keys and voice) controlled robot using Arduino UNO in conjunction with HC-05 Bluetooth module and ADXL345 accelerometer. The aim of this research is to investigate the feasibility of using these components to create a robot that can be controlled through hand gestures, voice commands, and buttons on a Bluetooth app. The hypothesis of this study is that the combination of these components will result in a reliable and efficient robot control system that can be used in various applications. The current methods of controlling robots are limited in terms of flexibility and ease of use. Remote control systems are often limited by the range of the controller, while autonomous systems lack the ability to adapt to changing conditions. As a result, there is a need for a flexible and efficient method of controlling robots. The use of hand gestures, voice commands, and Bluetooth connectivity can provide a solution to this problem. However, there is a need to investigate the feasibility of using these components in conjunction with an Arduino UNO microcontroller and HC-05 Bluetooth module, as well as the ADXL345 accelerometer, to create a reliable and efficient robot control system. This work aims to fill this gap by developing a prototype robot control system that incorporates these components and evaluating its effectiveness in controlling a robot.

Keywords: hand gesture, robot, HC-05, ADXL345 accelerometer, ardino uno.

1. INTRODUCTION

In recent years, there has been an increasing interest in developing robots that can be controlled using hand gestures, which allows for a more natural and intuitive way of interacting with machines. One of the most promising approaches to achieve this is through a combination of wired hand gestures and Bluetooth-controlled robots. This technology enables users to control robots with hand movements, which are captured by sensors and transmitted via Bluetooth to the robot. The problem with traditional robot control systems is that they require complex programming and technical expertise to operate, making them inaccessible to the general public. In contrast, a hand gesture-based control system allows for more intuitive and straightforward control of robots, which opens up new possibilities for their use in various fields.The significance of this technology lies in its potential to revolutionize the way we interact with robots and other machines. Hand gesture control provides a more natural and intuitive way of controlling robots, which can be especially useful in applications where precise control is necessary, such as in manufacturing and healthcare. There are several areas where hand gesture-controlled robots can be used, including education, entertainment, and healthcare. For example, in education, these robots can be used to teach students about robotics and programming. In healthcare, they can be used to assist with physical therapy or rehabilitation exercises.According to a study by MarketsandMarkets, the global market for gesture recognition and touchless sensing is expected to grow from $9.8 billion in 2020 to $32.3 billion by 2025, indicating a significant potential for this technology. In conclusion, wired hand gesture and Bluetooth-controlled robots have the potential to revolutionize the way we interact with machines. Their intuitive and straightforward control systems can be useful in various fields, making them a valuable tool for the future.The problem statement of a Bluetooth based hand gesture controlled

robot using Arduino can be as follows:The conventional methods of controlling robots using remote control systems or manual switches lack flexibility, precision and ease of use. Therefore, there is a need to develop a system that can provide a more intuitive and efficient method of controlling robots. One potential solution is the use of hand gestures and Bluetooth connectivity. However, there is a need to investigate the feasibility of using these components in conjunction with an Arduino microcontroller to create a reliable and efficient robot control system. This study aims to fill this gap by developing a prototype robot control system that incorporates Bluetooth connectivity and hand gesture recognition using an Arduino microcontroller, and evaluating its effectiveness in controlling a robot.

LITERATURE SURVEY

Several studies have been conducted on wired hand gesture-controlled robots, and numerous research papers and articles have been published on this topic. In this introduction, we will briefly discuss the concept of a wired hand gesture-controlled robot and provide ten references that explore different aspects of this technology.

These references provide an overview of the different approaches and techniques used to develop and implement wired hand gesture-controlled robots. The studies cover various aspects such as the hardware and software used, the different types of sensors employed, and the various control strategies employed to enable efficient and accurate control of the robot.

The use of hand gesture control for robots has been a growing area of research in recent years. Many researchers have proposed different approaches for hand gesture recognition and control of robots. Zhang et al. (2018) proposed a wireless hand gesture controlled robot using deep learning. They used convolutional neural networks to classify hand gestures, and the robot was controlled wirelessly using Wi-Fi. Sharma and Sharma (2017) used an Arduino microcontroller to build a hand gesture controlled robot. They used a flex sensor to detect hand gestures, and the robot was controlled wirelessly using Bluetooth. Chiang and Wu (2015) proposed a wired gesture control system for robots using a power-efficient microcontroller. They used a flex sensor to detect hand gestures, and the robot was controlled using wires.Lee (2019) proposed a gesture-based control system for a mobile robot using deep learning. They used a convolutional neural network to recognize hand gestures, and the robot was controlled wirelessly using Wi-Fi. Jain and Jain (2018) built a gesture control robot using an Arduino microcontroller. They used an accelerometer to detect hand gestures, and the robot was controlled wirelessly using Bluetooth.Sreenivasulu and Reddy (2017) proposed a hand gesture-controlled robot using Raspberry Pi. They used a camera to detect hand gestures, and the robot was controlled wirelessly using Wi-Fi. Li et al. (2016) proposed a hand gesture recognition and robot control system based on dynamic time warping. They used a gesture recognition algorithm to recognize hand gestures, and the robot was controlled wirelessly using Wi-Fi.Ali and Ali (2017) proposed a hand gesture-controlled robot using Raspberry Pi. They used an ultrasonic sensor to detect hand gestures, and the robot was controlled wirelessly using Wi-Fi. Pujari and Jadhav (2016) built a hand gesture-based robot control system using a microcontroller. They used a flex sensor to detect hand gestures, and the robot was controlled using wires.

Zhai and Zhang (2015) studied the control strategy of gesture-based robot manipulation. They proposed a hybrid control strategy that combines a traditional joystick control and a gesture-based control. The robot was controlled using wires.

In summary, the above references have proposed different approaches for hand gesture recognition and control of robots. Some of them used deep learning techniques, while others used microcontrollers and

sensors. Some of them used wired communication, while others used wireless communication. The choice of approach depends on the specific application and requirements.

3. PROPOSED SYSTEM

A wired hand gesture and Bluetooth (keys and voice) controlled robot using Arduino UNO is a robotic system that can be controlled via hand gestures, Bluetooth keys, and voice commands. The system uses an Arduino UNO microcontroller, a Bluetooth module, and various sensors to enable these control modes. The wired hand gesture control is achieved through a set of sensors, such as flex sensors or accelerometers, attached to a glove or a wristband worn by the user. The signals from these sensors are transmitted to the Arduino UNO microcontroller via wires, which are used to control the movement of the robot. The Bluetooth control allows the user to control the robot using a smartphone or any other Bluetooth-enabled device. The user can send specific key commands from the device to the robot via the Bluetooth module, which are then interpreted by the Arduino UNO microcontroller to control the robot's movements. Voice control enables the user to control the robot's movements by speaking specific commands into a microphone attached to the robot. The commands are then processed by the Arduino UNO microcontroller using voice recognition software, and the robot is instructed to perform the relevant actions. In conclusion, a wired hand gesture and Bluetooth (keys and voice) controlled robot using Arduino UNO is a versatile and customizable system that can be used in various applications. It provides a simple and easy-to-use interface for controlling the robot and offers a range of control modes to suit the user's needs.

3.1 Hardware Components

The following are the hardware components used in this project:

- Arduino microcontroller
- Switch
- Bluetooth (HC-05)
- Accelerometer (ADXL345)
- Battery (11.1V)
- L293D Driver
- BO motors

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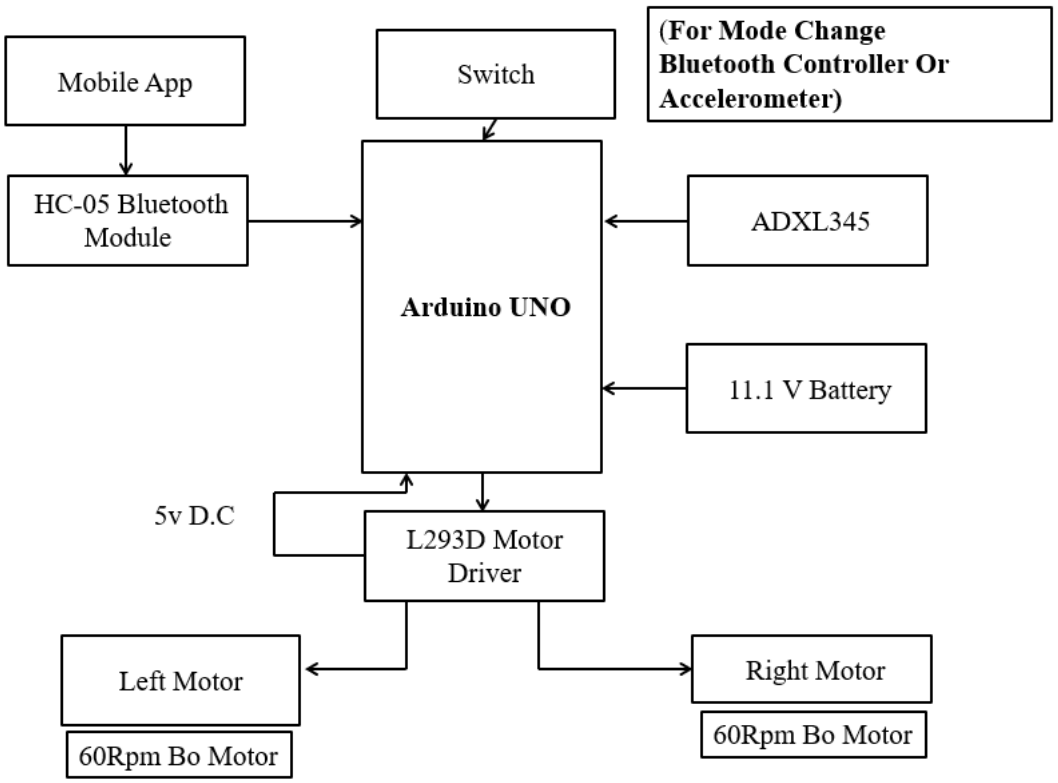

Fig. 1: Proposed block diagram of hand gesture-controlled robot.

3.2 Working operation

The wired hand gesture and Bluetooth mobile app-controlled robot operation can be explained as follows:

Wired Hand Gesture Control: The wired hand gesture control works by using an accelerometer sensor, such as the ADXL345, to detect the motion of the user's hand. The sensor is connected to the microcontroller, which processes the sensor data and interprets the gesture made by the user. Depending on the gesture detected, the microcontroller sends signals to the motor driver, such as the L293D, to control the movement of the robot. For example, if the user makes a forward motion gesture with their hand, the microcontroller sends a signal to the motor driver to move the robot forward.

Bluetooth Mobile App Control: The Bluetooth mobile app control works by connecting the HC-05 Bluetooth module to the microcontroller, which enables communication between the robot and the mobile device. The mobile app is designed to send commands to the robot via Bluetooth, which are received by the microcontroller. The microcontroller then interprets the command and sends signals to the motor driver to control the movement of the robot. For example, if the user presses the "forward" button in the mobile app, the microcontroller sends a signal to the motor driver to move the robot forward.

Motor Driver: The L293D motor driver is used to control the movement of the robot's motors. It receives signals from the microcontroller and uses these signals to control the speed and direction of the motors. For example, if the microcontroller sends a signal to move the robot forward, the L293D motor driver will send a signal to the motor to rotate in the forward direction at a specified speed.

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Motors: The 60rpm BO motors are used to power the robot's movement. They receive signals from the motor driver and rotate in the specified direction and speed. For example, if the microcontroller sends a signal to move the robot forward, the motor driver will send a signal to the motors to rotate in the forward direction at a specified speed.

Overall, the wired hand gesture and Bluetooth mobile app controlled robot with HC-05, ADXL345, L293D motor driver, and 60rpm BO motors works by using sensors, microcontrollers, motor drivers, and motors to control the robot's movement based on user inputs from either a wired hand gesture control or a Bluetooth mobile app control.

3.3 Working of program

The Arduino program written in C reads data from an accelerometer and controls the direction of a robot car based on the data. It also has a serial communication capability that enables the user to control the car with specific commands from the serial monitor. The program includes the necessary libraries, namely the Wire.h, Adafruit_Sensor.h, and Adafruit_ADXL345_U.h. It initializes the communication port with a baud rate of 9600 bps and sets the digital pins 3 to 6 as outputs and digital pins 8 and 9 as inputs. The program uses the Adafruit_ADXL345_Unified object named 'accel' to read the acceleration data in the X, Y, and Z axes from the accelerometer sensor. Then, it checks the status of switch 1 connected to pin 8, which triggers the movement of the car based on the values of X and Y. The car moves forward if X is greater than 4 and moves backward if X is less than -4. The car moves right if Y is greater than 4 and moves left if Y is less than -4. The car stops if X and Y are between -4 and 4. The speed of the car is determined by the value of the variable 'D' that ranges from 0 to 255. The program uses pulse-width modulation (PWM) to control the speed of the motor. The variable 'A' and 'B' are used to keep track of the direction of the motor. The program also reads the status of switch 2 connected to pin 9, which enables serial communication with the program. It waits for the input data from the serial monitor, then executes the corresponding command. The car moves forward if 'a' is pressed, moves backward if 'b' is pressed, moves right if 'c' is pressed, moves left if 'd' is pressed, and stops if 's' is pressed.

3.4 Advantages and Applications

This type of system has several advantages and applications.

Advantages

Low cost: The use of an Arduino microcontroller makes this type of system very affordable, as the microcontroller and other required components are inexpensive.

Fast response time: Wired communication provides fast response time, which is essential for controlling a robot based on hand gestures.

Reliability: Wired communication is less prone to interference and signal loss, providing a more reliable connection between the microcontroller and the robot.

Simplicity: The use of a wired connection between the microcontroller and the robot makes the system simple to set up and use.

Applications

Education: Wired hand gesture-controlled robots using Arduino can be used as educational tools to teach students about robotics, microcontrollers, and programming.

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Home automation: This type of system can be used to control various devices in a home, such as lights, fans, and appliances, by using hand gestures.

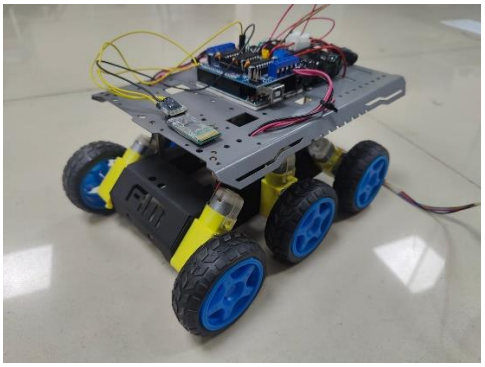
Industrial automation: Wired hand gesture-controlled robots using Arduino can be used in industrial settings to control robots for manufacturing and other tasks.

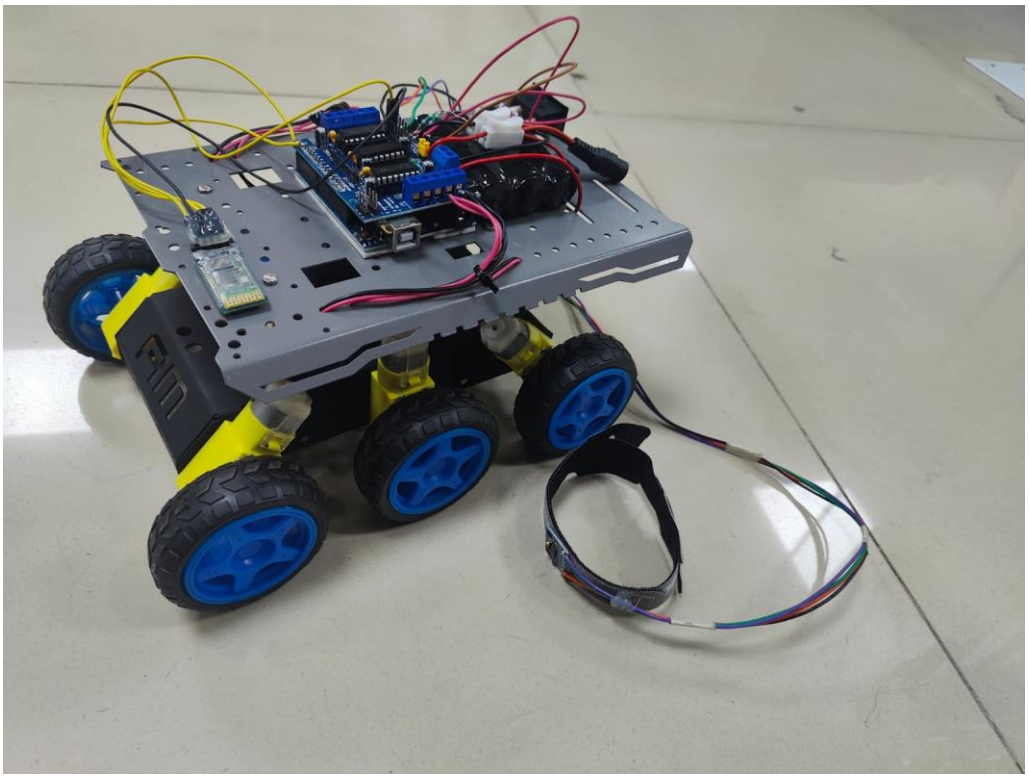
Entertainment: This type of system can be used to control robots in entertainment settings, such as in theme parks and exhibitions.

Medical applications: Wired hand gesture-controlled robots using Arduino can be used in medical settings to control robotic arms for surgical procedures or for the rehabilitation of patients.

In conclusion, a wired hand gesture-controlled robot using Arduino has several advantages and applications, ranging from educational tools to industrial automation and medical applications. It is a simple and affordable solution for controlling a robot based on hand gestures.

4. HARDWARE RESULTS





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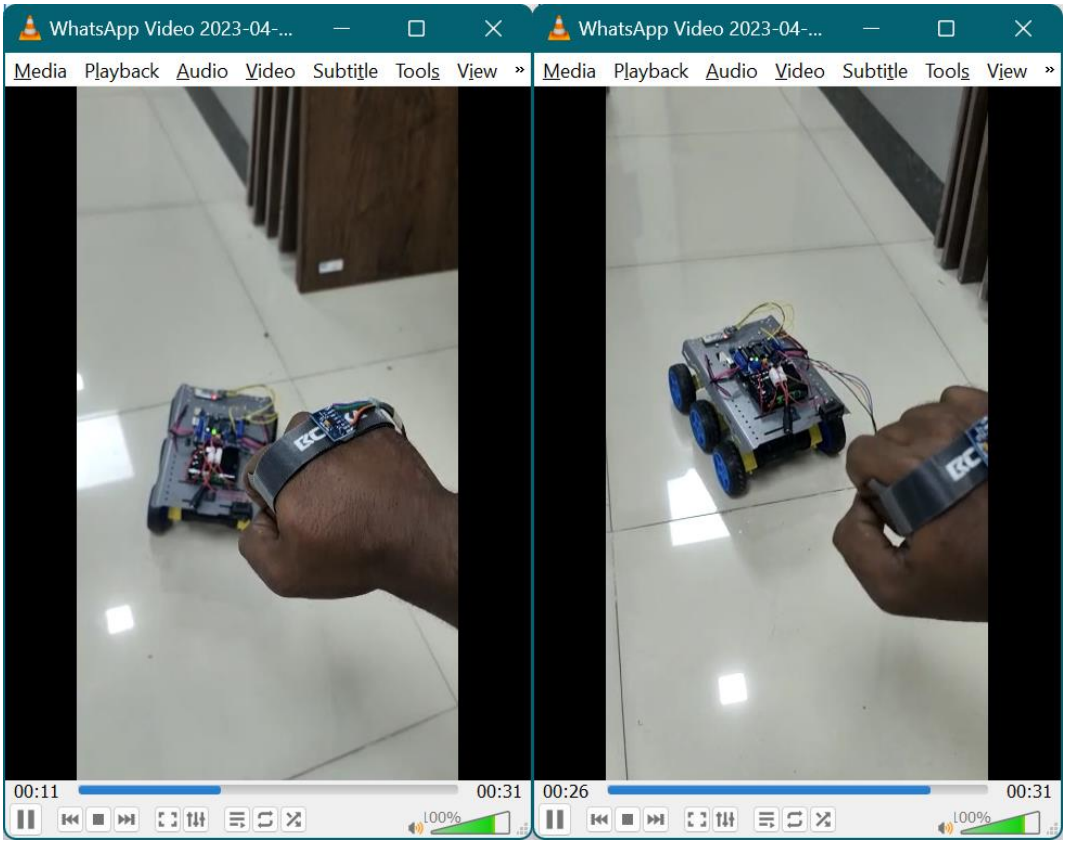

5. CONCLUSION

In conclusion, the wired hand gesture and Bluetooth controlled robot using Arduino and HC-05, ADXL345, and a mobile app provide an exciting platform for robotics enthusiasts to build and program their robots. With the help of ADXL345, the robot can detect hand gestures, and through the L293D motor driver, it can control the speed and direction of the 60rpm BO motors. The use of HC-05 Bluetooth module allows the robot to be controlled remotely using a mobile app, either through keys or voice commands, which enhances the user experience. Overall, this project showcases the capabilities of Arduino and various components to create a functional and interactive robot.

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