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APDS BASED NON-CONTACT HAND GESTURE BASED WIRELESS ROBOT

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ABSTRACT:

Traditional wheelchair versions sometimes need manual assistance or joystick controls, which may be difficult for those with restricted mobility, although an estimated 6 million people worldwide depend on these devices because of paralysis. Although they are an improvement, joystick-operated wheelchairs aren't always suitable for those with severe physical limitations because of the amount of physical power required to operate them and the fact that the controls are stiff and only point in one direction. To overcome these shortcomings, a new method has been devised that makes use of APDS (Ambient Light and Proximity Detection Sensor) technology to provide non-contact gesture control. Without the need for physical touch or force, this technique allows for intuitive wheelchair mobility with simple hand tilts. Because it is ambidextrous and the wheelchair can come to the user when called upon, it greatly improves the user's independence. This configuration is designed to be easily implemented in real-world scenarios since it is created using affordable Arduino platforms like UNO and NANO and is programmed using the Arduino IDE.

Keywords: Gesture control, Arduino nano, transmitter,receiver,encoder,decoder,ultrasonic sensor.

INTRODUCTION:

Robotics has come a long way in the last few years, and it now plays a crucial role in contemporary technology. Autonomous and semi-autonomous modes of operation are available to robots, which are fundamentally programmable electro-mechanical systems. Ideal for high-speed and precise jobs, particularly in industrial settings, autonomous robots work autonomously by detecting and understanding their surroundings without human interaction. Whereas fully autonomous robots can handle highly predictable conditions with ease, semi-autonomous ones still require human intervention to a greater or lesser extent.

Gesture control is one of the most popular techniques of human-machine interface since it is easy to learn and use. In contrast to conventional systems that depend on buttons or remote controls, robots that are controlled by gestures react to the organic motions of the human hand. The user is usually required to wear a transmitting device that uses accelerometers and other sensors to identify hand motions in these systems. The robot may then receive these

instructions in the form of directions or actions and carry them out without any human intervention thanks to the data sent to it wirelessly.

Arduino Nano, MPU6050 accelerometer, RF transmitter, and HT-12E encoder are some of the key components of gesture-based control systems. An HT-12D decoder is used to decipher the signals that are captured by an RF receiver on the receiving side. After deciphering the instructions, an Arduino UNO processes them and tells the motor drivers to do the necessary motions. The system is made more manageable for troubleshooting and future updates thanks to its modular architecture.

Separating the system's transmitter and receiver into their own functional units improves performance and reliability. Additional benefits of this design style include improved debugging and scalability. A wide variety of industries may benefit from gesture-controlled robots, including construction, healthcare, manufacturing, and military. In situations where remote operation is required, like firefighting or hazardous material handling, their capacity to navigate and execute tasks based on human gestures makes them particularly important.

Machines nowadays are able to mimic human behavior to an astounding extent, thanks to the ongoing development of robotics. The trend toward gesture-based interfaces is making robot-human interaction more natural and natural-feeling, even if some robots still need external control via computers or remotes. The future of human-machine collaboration is bright, thanks to more intelligent robots that can understand and react to human intent with little to no human intervention. This development brings us one step closer to building autonomous robots that improve our lives in many ways.

GESTURE RECOGNITION:

The field of gesture recognition is a relatively new one in the fields of computer science and human-computer interaction. Its primary goal is to use mathematical models and computational algorithms to understand human bodily gestures, namely hand and face motions. A more natural and intuitive method of communication between people and gadgets is made possible by this technology, which allows robots to comprehend gestures either during or after the contact. There are many uses for hand gestures beyond emotion detection, such as sign language translation, controlling robots, and manipulating virtual objects. Facial motions are more typically employed for emotion detection. Machines can now better grasp human actions in context thanks to advancements in the area that go beyond ocular inputs to assess full-body posture, movement patterns, and even social behaviors such as spacing and orientation.

Instead of using conventional input methods like touchscreens or keyboards, gesture recognition uses sensors like accelerometers, infrared cameras, and depth sensors to record the user's movements. The system is able to distinguish between delicate motions by analyzing these signals using pattern recognition and image processing algorithms. Online gestures allow for manipulation of items in real-time, such zooming or rotating

them; offline gestures, on the other hand, are detected after the fact, like sketching a form to activate a command. Gesture recognition is opening the door to touchless interfaces in industries like gaming, VR, car controls, and assistive technology, which provide a more accessible and engaging digital experience by doing away with the requirement for physical touch.

OBJECTIVE:

Toy cars have always required a remote control, but this project intends to revolutionize that process by replacing it with a system that uses accelerometers and APDS sensors embedded in wearable gloves. One glove uses an APDS sensor to control the throttle, while the other uses an accelerometer to control the direction of travel, including turning left or right. The sensors' sensitivity and responsiveness were first fine-tuned via studies with calibration. An Arduino microprocessor analyzed the sensor data after proper capturing, and then it was wirelessly communicated via RF modules to another Arduino on the automobile. This Arduino subsequently instructed the motor driver to execute the motion. A more realistic and hands-free driving experience was achieved by optimizing the toy car's mechanical construction to guarantee quick gesture-based control.

PROBLEM STATEMENT:

Due to cable limits and cumbersome interfaces, traditional button-controlled robots sometimes have restricted movement and cause user discomfort. In order to circumvent these restrictions, this research presents a smart glove-operated, wireless hand-gesture robot. Embedded in the glove are motion-detecting sensors that translate a user's hand motions into electrical impulses in real-time. After receiving these signals, the robot receives the data wirelessly via an embedded LilyPad microcontroller in the glove, which also functions as a transmitter. This method not only gives the user more leeway, but it also gets rid of the need for a physical connection, so they can direct the robot with more fluid, natural motions from a longer distance.

The data that is sent is received by a wireless receiver module that is linked to a microcontroller. In order to accomplish actions like moving and turning, the microcontroller uses this data to decipher certain instructions and converts them into motor control signals. Improving mobility assistance for people with physical limitations was a major inspiration for the system. The project's goal is to help people, particularly those with physical limitations, handle assistive devices more naturally using gesture recognition technology. This will reduce physical strain, increase independence, and improve quality of life.

LITERATURE SURVEY:

By reducing the amount of physical effort needed to operate conventional joystick-controlled devices, the idea of a voice-controlled wheelchair seeks to greatly improve the mobility and independence of those with physical limitations. Users are able to control the wheelchair's pace and direction by merely speaking orders, thanks to this technology that uses speech

recognition to understand certain words. By lowering the probability of unintentional contacts with obstructions, such a system not only streamlines human interaction but also incorporates safety elements. Most importantly, this voice-operated method can be created at a low cost, which means it can be used by more people. Better voice training algorithms and recognition systems that are immune to noise are examples of the kinds of innovations that are required to increase responsiveness and dependability.

At the same time, GCUI have become more popular as a natural way to interact, especially for those who have trouble with traditional input techniques. Glyndŵr University researchers Moniruzzaman Bhuiyan and Rich Picking provide insight on the evolution and possibilities of GCUI in several domains of application. They looked at research from over 30 years and concluded that gesture-based systems work particularly well in ambient and ubiquitous computing settings. Improving the quality of life for users and extending the frontiers of accessible technology might be achieved by integrating gesture and speech interfaces with assistive equipment like wheelchairs. This could lead to more adaptable, intuitive, and inclusive solutions as technology continues to progress.

PROPOSED SYSTEM:

It is still very difficult to design wheelchair control systems that are accessible, especially when trying to strike a balance between system quickness and limited memory and processing capability. Those who have severe physical limitations, particularly those who are unable to use their limbs, find traditional joystick-operated wheelchairs very challenging to use. As a potential solution, voice-controlled devices that use speech recognition to allow for hands-free operation are worth considering. People with severe paralysis or motor limitations may benefit greatly from these systems since they can control the wheelchair's movement by interpreting precise spoken instructions.

The main goal of this project is to create and execute a voice recognition interface that can recognize and react to spoken instructions effectively, enabling users to manage the pace and direction without using their hands. This technique reduces physical strain and increases user independence compared to standard input methods. The device shows promise as an affordable, accessible way to improve mobility and quality of life for those with severe impairments. However, it still needs improvements in noise filtering and the accuracy of command recognition, particularly in situations that are constantly changing.

BLOCK DIAGRAM:

TRANSMITTER:

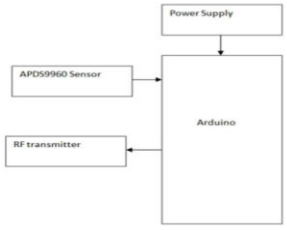

Fig 1: Transmitter block diagram

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RECIEVER :

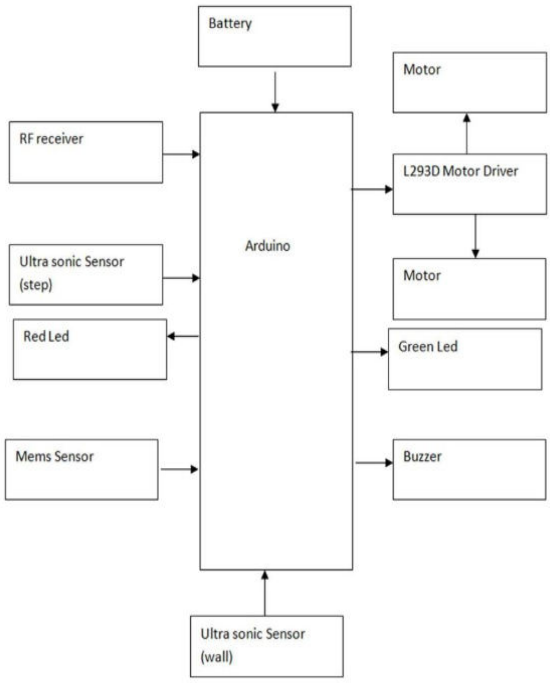

Fig 2: Receiver block diagram

WORKING PRINCIPLE:

• With its cutting-edge gesture recognition, real-time obstacle detection, and wireless communication capabilities, the APDS-9960-based contactless gesture-controlled robot provides a high-tech answer to the problem of hands-free robotic operation. A fluctuation in the infrared light reflected from the user's hand is detected by the APDS-9960 sensor, which allows the system to understand directional hand movements like up, down, left, and right. A motor driver receives a signal from an Arduino Nano, which processes the gesture recognition data and sends it on to the robot for accurate navigation.

A built-in ultrasonic sensor actively searches the robot's environment for any obstacles, adding to its autonomy and safety. In order to avoid accidents, the system can determine distances and make movement adjustments based on the time gap between sent and received ultrasonic pulses. Eliminating the requirement for direct touch or tethered controls, wireless modules allow distant communication between the robot and controller. This robot is perfect for places where little physical touch is required for reasons of cleanliness, safety, or efficiency, including hospitals, labs, or industrial zones, thanks to its mix of autonomous navigation and non-contact gesture detection.

SCHEMATIC DIAGRAM:

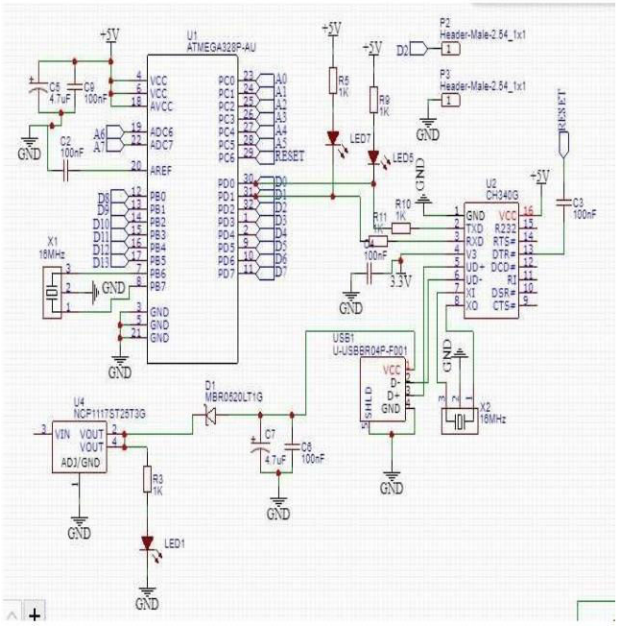

Fig 3: Schematic diagram

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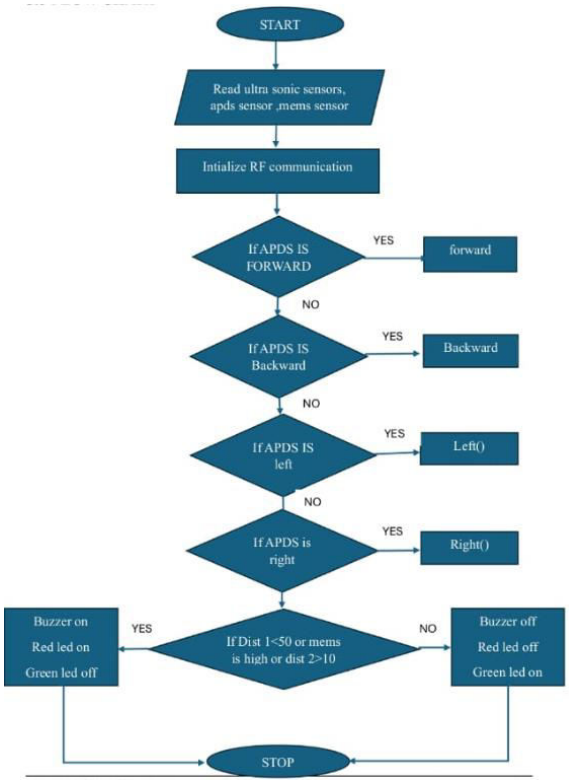
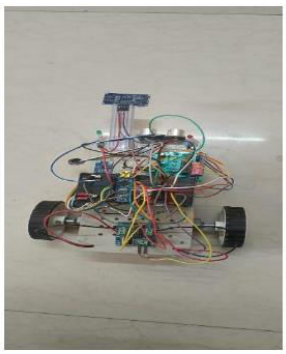
FLOW CHART:



RESULT:

This project focuses on the design and development of a wheelchair controlled through gesture recognition, offering a more intuitive and hands-free method of operation for users. By integrating an APDS sensor, the system captures and interprets specific hand gestures made by the user to control the wheelchair's movement. The APDS sensor detects these gestures, which are then processed by an embedded microcontroller to send appropriate commands to the wheelchair's motor, allowing it to move in the desired direction. This innovative approach enhances accessibility and mobility for individuals with limited physical abilities, providing them with greater independence and ease of control without the need for traditional manual input devices like joysticks or buttons.



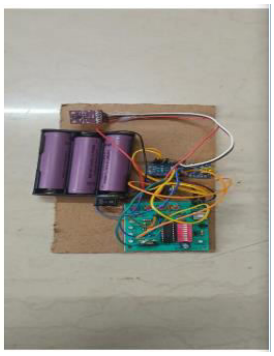


Fig.4.a: Reciever robot part
fig.4.b: Transmitter part

Those who are unable to walk due to age or disability may find a new sense of independence with the wheelchair prototype seen above, which is controlled by hand gestures. The technology provides a natural and hands-free method of navigating by deciphering the user's hand movements and directing the wheelchair accordingly. An alarm mechanism that activates a red LED and buzzer in the event of a user fall from the chair is one of the safety measures included in the prototype. Further assurance of a risk-free ride is provided by the wheelchair's ability to identify impediments and come to a complete stop to avoid crashes. This design is perfect for enhancing patients' mobility and independence in scenarios when physical touch is not safe or voice control is not an option.

ADVANTAGES AND APPLICATIONS

ADVANTAGES:

This voice-controlled device is easy for persons with disabilities such as cerebral palsy and quadriplegia to use.

• Lessening software and hardware interface issues, Arduino makes system programming a breeze.

Thanks to the use of Arduino and motor drivers, the system is completely automated, and it can be controlled by synthetic voice commands.

APPLICATIONS:

1. Scientific use.

2. Military and Law Enforcement use.

3. Search and Rescue.

4. Forest conservation.

CONCLUSION & FUTURE SCOPE

CONCLUSION:

i. An APDS sensor and an Arduino microcontroller will be used in this project to create a gesture-controlled robot that can assist those with impairments. For those who have trouble moving about, this technology creates an easy-to-understand interface that lets them direct the robot's movements with their hands.

ii) This concept not only provides an affordable alternative to current wheelchair models, but it also gives conventional electric wheelchairs a run for their money. Users may effortlessly use the wheelchair with minimum effort thanks to the system's reliance on simple gesture-based instructions, which reduce the need for sophisticated controls.

iii) By allowing physically impaired people more freedom, the technology is meant to greatly enhance their day-to-day lives. Automated, energy-efficient, and with improved safety features, the wheelchair is a practical and pleasant option that may provide users confidence and ease while navigating their surroundings.

iv. Existing joystick-controlled wheelchairs may also benefit from this technology's integration, which enhances both safety and efficiency. Users will have a safer and more regulated experience because to the system's ability to avoid collisions with things like walls, furniture, and other people. Because of this, the wheelchair's ability to safeguard users when they move about in different surroundings is even more enhanced.

FUTURE SCOPE:

The proposed voice recognition system utilizes a specialized voice recognition module to control the movement of the wheelchair, allowing users to issue voice commands for easy navigation. The system is built around an Atmega328 microcontroller and a DC motor circuit, which work in tandem to drive the wheelchair based on the recognized voice input. To ensure smooth operation, the system is designed to function in a quiet environment, with the accuracy of voice recognition relying heavily on clear pronunciation and close proximity to the microphone. This setup ensures that the

system can accurately interpret commands without interference.

For enhanced performance, a gearbox is employed to achieve high-speed movement, while Pulse Width Modulation (PWM) is utilized to further optimize the wheelchair's speed. To make the system more sustainable, a solar panel can be integrated to charge the battery, providing a renewable power source for the components. The wheelchair's design is optimized for users with a total load not exceeding 50 kilograms. Additionally, the system includes obstacle avoidance sensors to help navigate around obstacles, ensuring safe and efficient movement in various environments.

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