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REAL-TIME GESTURE OPERATED ROBOTIC ASSISTANT FOR SPECIALLY-ABLED USERS

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ABSTRACT

The ability to perform independent mobility and basic tasks remains a significant challenge for many specially-abled individuals. To address this need, the present work proposes a **Real-Time Gesture Operated Robotic Assistant** controlled through intuitive hand movements using Arduino-based embedded hardware. The system integrates an accelerometer or gesture sensor with a microcontroller to continuously capture, process, and interpret user gestures in real time. The interpreted commands are wirelessly transmitted to a mobile robotic platform equipped with motor drivers and assistive modules to execute corresponding actions such as movement, direction control, and object handling. This contactless control mechanism eliminates the need for conventional physical interfaces, making the solution user-friendly, hygienic, and highly accessible. Experimental implementation demonstrates reliable gesture recognition, low latency response, and smooth robotic operation, validating the system's effectiveness for assistive applications. The proposed approach offers a cost-efficient, scalable, and customizable solution to enhance independence, safety, and quality of life for specially-abled users.

KEYWORDS: Gesture-controlled robot, Hand gestures, Wireless communication, Actuators Real-time interaction, Gesture recognition, sensors.

INTRODUCTION

Recent advances in robotics and assistive tech have fueled innovative solutions for enhancing the lives of individuals with disabilities. Among these, gesture-controlled robots offer a promising path to greater accessibility and independence. This project leverages Arduino-based systems to enable intuitive interaction with robots, addressing the challenges posed by traditional input devices. By allowing users to control movements through hand gestures, the project aims to empower individuals with disabilities to navigate their environments more effectively. With a focus on tailored design and real-time gesture interpretation, the project holds potential to significantly improve quality of life and promote inclusivity in robotics and assistive technology.

RELATED WORK

In recent times several initiatives have been explored in the intersection of gesture control and assistive robotics to enhance accessibility for individuals with disabilities. Projects such as the Myo armband system have demonstrated the potential of wearable technology in enabling gesture-based control of robotic devices. By capturing electromyographic signals from muscle movements, the Myo armband allows users to intuitively interact with computers, virtual reality environments, and robotic prosthetics, offering a versatile platform for assistive applications.

Additionally, research efforts have focused on developing gesture recognition algorithms tailored to the unique needs of individuals with disabilities. Studies have investigated machine learning techniques for interpreting a wide range of gestures, including those with limited dexterity or mobility. By refining gesture recognition models and incorporating adaptive features, researchers aim to create robust and inclusive interfaces that cater to diverse user abilities, thereby enhancing the usability and effectiveness of gesture- controlled systems in assistive contexts.

Furthermore, collaborative initiatives between academia and industry have yielded advancements in the design and implementation of gesture-controlled robots specifically tailored to the needs of individuals with disabilities. These projects emphasize user-centered design principles and participatory approaches to ensure that robotic systems align closely with user preferences and requirements. By integrating user feedback and incorporating accessibility features, researchers strive to develop assistive robots that empower individuals with disabilities to lead more independent and fulfilling lives.

PROPOSED SYSTEM

The robot enables users to control its movements through hand gestures, leveraging an accelerometer and Arduino Nano microcontroller. Accelerometer detects hand movements, with Arduino processing the data and encoding it via an H12E encoder into a serial data stream. Commands are wirelessly transmitted to the robot's receiver section using a radio transmitter module, allowing real-time execution of gestures.

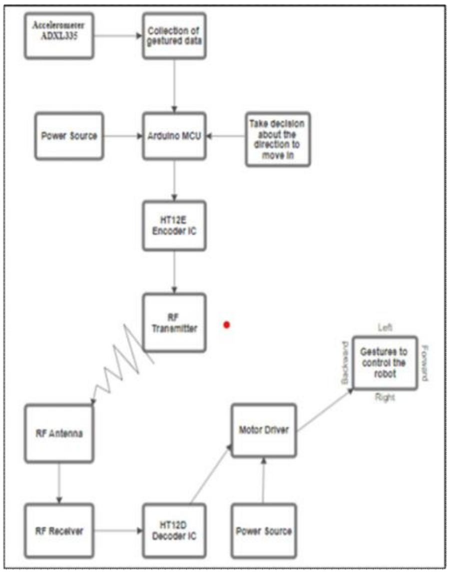

Fig.1 Block diagram for gesture control.

In addition to gesture control, the robot integrates GPS and GSM modules for real-time location sharing upon user request. The GPS continuously tracks the robot's coordinates, while the Arduino communicates with the GSM module to transmit location updates via SMS commands. Receiver module captures and decodes signals transmitted by the handheld device, interfacing with a microcontroller to generate commands for the robot's movements. It may also facilitate communication with GSM and GPS modules, and manage power consumption for efficiency.

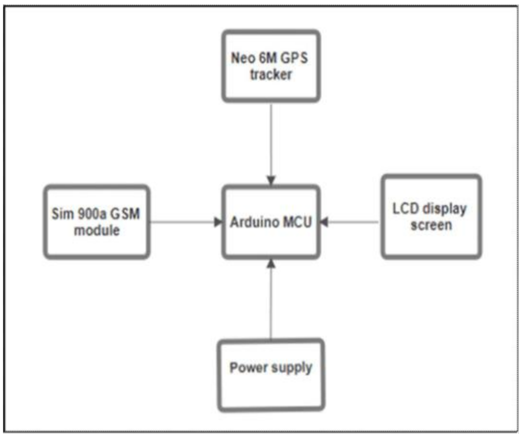

Fig.2 Block diagram for live location tracking.

RESULTS

The gesture-controlled robot project demonstrated the feasibility and effectiveness of using hand gestures to control robotic systems. Through testing, it showed promising results, emphasizing its performance, usability, and real-world applicability. Key findings included successful implementation of gesture recognition algorithms, ensuring reliable control of the robot's movements. Wireless communication between the handheld device and the robot's receiver module proved robust, enabling smooth transmission of gesture commands within 2 seconds. The robot exhibited responsive and precise movement capabilities, showcasing its potential for dynamic environments.

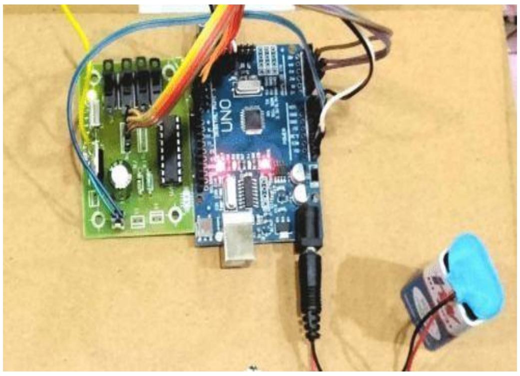

Fig.3 Transmitter module

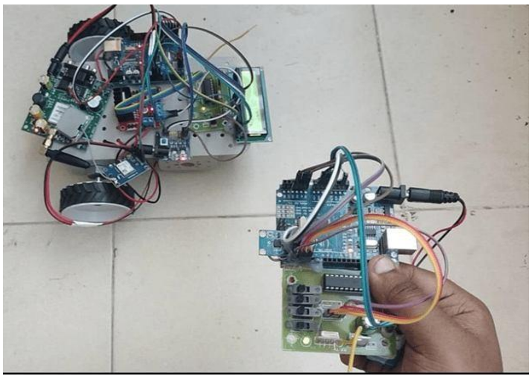

Fig.4 Receiver module

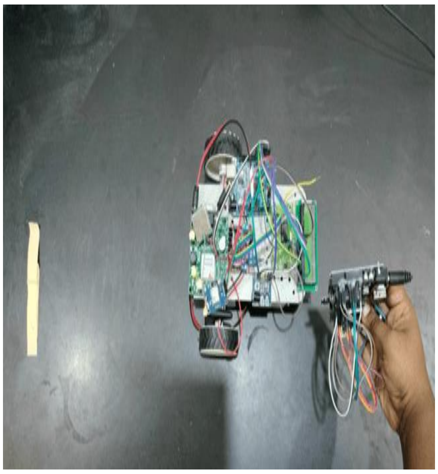

Fig.5 Forward movement

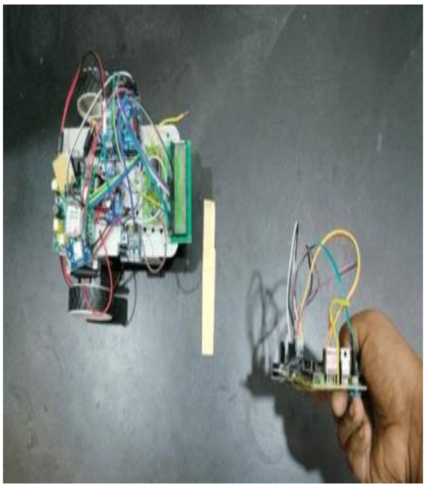

Fig.6 Backward movement

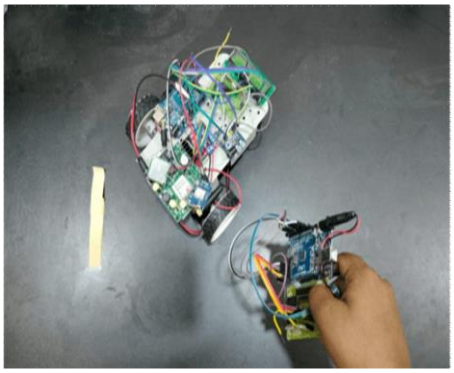

Fig.7 Left movement

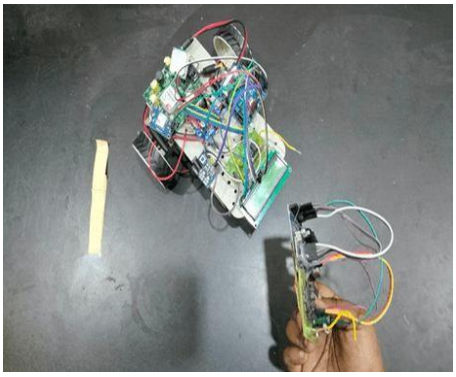

Fig.8 Right movement

Fig.9 Starting message

Fig.10 Number registration

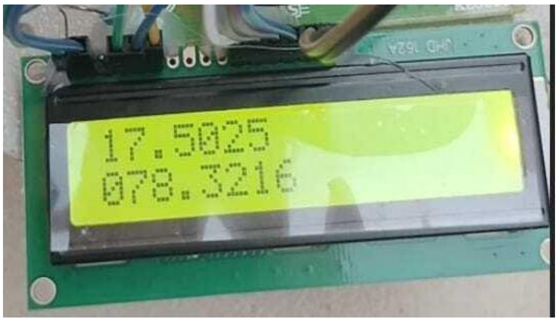

Fig.11 Live location latitude and longitude

Fig.12 Communication between

Upon activation, the robot displays a message on the LCD screen, signalling readiness. It then sends a message with a designated phone number, awaiting acknowledgment denoted by "reg". Subsequently, a request message (*s#) is dispatched to obtain the live location. Finally, the system responds with a message containing the current location, completing the operational sequence. This systematic approach ensures efficient communication and real-time location updates.

CONCLUSION

The gesture-controlled robot project marks a breakthrough in human-robot interaction, offering intuitive control via hand gestures. Utilizing gesture recognition and wireless communication, it facilitates natural interaction across entertainment, assistive tech, and education. Despite challenges like gesture complexity, refinement promises a transformative impact on automation, paving the way for a future where gesture-controlled robotics enrich our daily experiences.

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