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DESIGN AND IMPLEMENTATION OF A ROBOT TO ASSIST BEDRIDDEN PERSON

Shivani R Shankar[1], Sanjana R[2], Afrah Majid[3] and Dr M V Sreenivas Rao[4]

UG student Department of Electronics and Instrumentation Engineering, GSSS Institute of Engineering and Technology for women, Mysuru- 570016, India[1-3]

Associate Professor, Department of Electronics and Communication Engineering[4], GSSS Institute of Engineering and Technology for women, Mysuru- 570016, India

ABSTRACT: Bedridden individuals often face a significant challenge when it comes to performing daily activities due to their inability to move. Such individuals have to rely on others for assistance with even the most basic tasks, which can lead to a feeling of dependency and a reduced sense of autonomy. This lack of independence can negatively impact their mental and emotional well-being, and can cause a decline in their overall quality of life. To address this issue, we designed and implemented a robot to assist bedridden individuals in performing various tasks. This robot combines a mobile robot with a versatile robotic arm, which is controlled through the Blynk platform. The Blynk platform is a mobile application that allows users to remotely control devices that are connected to the internet. With the help of the ESP8266 microcontroller and L298N Motor driver, the robot can be easily maneuvered. The robotic arm utilizes servos to perform a wide range of angular movements, making it capable of performing many activities that were previously impossible for bedridden individuals. This technology allows bedridden individuals to perform tasks like object manipulation and relocation, providing them with a newfound sense of independence and significantly improving their quality of life.

KEYWORDS: NodeMCU, Mobile robot, Robotic arm, Blynk IoT

I.INTRODUCTION

This project focuses on the development of a robotic arm mounted on a mobile robot platform designed specifically for bedridden individuals. By leveraging robotic technology, this system aims to provide assistance to such individuals in performing everyday tasks with ease. The robotic arm is being designed to be lightweight, flexible, and safe for use around bedridden individuals. Additionally, the mobile robot platform will be compact, stable, and user-friendly for seamless navigation in confined spaces. The control mechanism utilizes the Blynk IoT app, allowing users to communicate with the robot via Wi-Fi and issue commands using control buttons and sliders. Overall, this innovative solution has the potential to significantly enhance independence, comfort, and overall quality of life for bedridden individuals by enabling them to carry out tasks and activities independently.

II.LITERATURE SURVEY

This section provides an overview of previous research papers and projects related to the topic design and implementation of a robot to assist bedridden person. The development of a wireless mobile robot arm is a timely and innovative solution to the growing demand for wireless connectivity in modern applications. This paper outlines the construction and analysis of a mobile robot arm that can perform pick and place operations via wireless control using a PS2 controller. The robot can move in different directions for a specific distance, based on the user's input. The system is built using the Arduino Mega platform, which interfaces with the wireless controller and the mobile robotic arm. The robot's performance is analyzed in terms of speed, distance, and load capacity. These metrics demonstrate the robot's capabilities in performing its intended functions and its efficiency in completing tasks [1]. The project involves designing a remotely controlled robotic arm for hazardous environments, such as quarantine rooms of COVID-affected patients. The arm, controlled via Wi-Fi using the Blynk IoT App, has 3 degrees of freedom and utilizes stepper motors. It allows technicians to monitor health conditions, collect samples, and deliver medications without direct human contact. The results indicate a 3% variation from simulated to actual performance when adjusting the slider [2]. This paper presents the development of a robotic arm using Arduino and a Potentiometer for industrial automation. The arm

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features four-directional movement controlled by servo motors. The Arduino UNO converts analog signals to digital signals for the servo motor. The project explores the technical aspects, challenges, and applications of robotic arms in industrial automation, including their potential use as artificial limbs for individuals with hand loss due to accidents [3]. The proposed project combines cloud computing, Internet of Things (IoT), and Arduino microcontroller to design a robotic arm capable of picking and placing objects. The arm is controlled via a web page interface using HTML commands. It utilizes four servo motors for various movements and incorporates two ultrasonic sensors to limit its operation area. The Proteus program is used for simulating the robot's control before hardware implementation [4]. This paper presents the development of a controller for a robotic arm using Internet of Things (IoT) technology. The arm's direction can be monitored and controlled remotely using internet connectivity. The Raspberry Pi board serves as the controller and web server system. The robotic arm consists of four servo motors individually controlled by pulse width modulation (PWM). The controller system is implemented using Python 2.7 programming language on Raspberry Pi, with Node-Red serving as the web server for communication with web browsers. The system allows users to access and control the robotic arm's direction through computers or smartphones. Practical test implementation verifies the results of the study [5]. This study focuses on designing a prototype of a mobile robot with a wireless-controlled robotic arm. The robot is a 6 Wheel Drive Robot equipped with a 6 Degree of Freedom robotic arm. Wireless control is achieved through a remote control based on XBee Pro Series 1. Data is transmitted serially from the remote control via XBee, processed on the receiver, and used to control the robot. Successful tests demonstrate the robot's capabilities in forward and backward movement, turning left and right, stopping, and linear movement, highlighting its potential for deployment [6]. Hiranmayee Panchangam proposes a mechanism for controlling a robot using computer science tools such as Python, Adafruit remote, and Raspberry Pi. The robotic arm is developed in conjunction with a personal computer for signal processing, with all components connected via serial communication. The prototype aims to address challenges related to handling hazardous or distant objects. Robotics is increasingly significant in various automation fields, and it is expected to continue advancing in the future, enhancing robotic behavior and effectiveness [7]. The paper presents a compact portable robot controlled by Arduino NodeMCU. It utilizes wireless control via Wi-Fi and incorporates obstacle detection. The main contribution is the efficient motion control system. The robot includes GPS for tracking and utilizes cloud services for storing commands and data. It features IR obstacle sensors and the architecture and design are described [8]. Hongli He and colleagues propose a smart mobile robotic arm controlled by gesture recognition. The system consists of a remote-control smart car with a robotic arm. The Leap Motion module is used for gesture recognition, and the position information of hands in 3D space is processed using the Processing API function. Bluetooth is used for communication between the car system and the controller, which is the STM32's NUCLEO-F411RE development board. The left-hand gesture controls car movement, while the right-hand gesture controls the robot arm's elbow, wrist, and grab motions. Experimental results demonstrate accurate and quick response, enabling various remote control operations based on gestures [9]. Mahendra Kanojia and colleagues discuss the use of IoT in various domains and focus on an IoT-based RC robotic car. The car can be controlled remotely via a specialized remote or mobile application. IoT enables live video streaming, accident avoidance using sensors, and the ability to shut down the fuel system remotely. The paper explores the use of Arduino and Raspberry Pi as microcontrollers for robotic car design, highlighting the real-time responsiveness of Arduino. Best practices, microcontroller architecture, programming models, and hardware/software comparisons are discussed, along with testing of the robotic car implementation [10]. These previous research papers provide insights for the development of the Robotic arm mounted on a Mobile robot.

III.METHODOLOGY

The Hardware components used to develop this work are NodeMCU ESP8266, Motor drive L298N, Servo Motors, Robotic arm, Step down voltage board, DC geared motors and Li-ion Batteries. To control the Mobile Robot and the Robotic arm Blynk IoT platform is used. The Android app transmits commands to the robot via Wi-Fi using the ESP8266 module. The micro-controller receives the commands and controls the movements of the robot and its robotic arm through slider switches. The Motor driver L298N is utilized to control the speed and direction of the robot through DC geared motors. The robot is powered by four Li-ion batteries, while the robotic arm is powered by two Li-ion batteries. A step-down voltage board is employed to ensure the servo motors receive the appropriate voltage for their movements. The voltage from the two Li-ion batteries is step-down to approximately 5.5V and then provided to the servo motors. The ESP8266 module is responsible for controlling the servo motors connected to the robotic arm. The robotic arm consists of three servo motors: Control (for up and down movements), Arm (for front and back movements), and Gripper (for object handling). The robot follows user commands to move in a specific direction, pick up objects, and return to a designated location. The Fig3.1 shows the Block diagram of Design and implementation of robot to assist bedridden person.

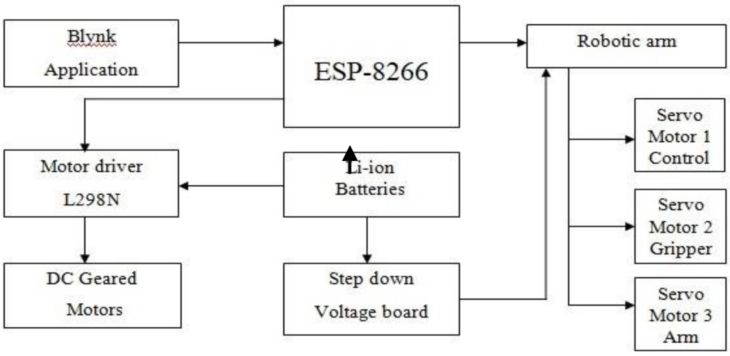

Fig3.1: Block diagram of Design and implementation of robot to assist bedridden person

IV.CIRUIT DIAGRAM AND FLOWCHART

The Fig4.1 shows the circuit connections of the Robotic arm mounted on a Mobile Robot. The positive and the negative terminals of dc geared motors are connected to the motor driver L298N. In lithium-ion battery of 15V the VCC and the Gnd are connected to the motor driver L298N screw terminals. In ESP8266 D2 pin is connected to the IN2 pin of Motor Driver. D1 pin is connected to the IN1 pin of Motor Driver. D8 D7 D6 pins are connected to the Robotic arm (PCB board). D5 pin is connected to the IN3 pin of Motor Driver. D0 pin is connected to the IN4 pin of the Motor Driver. The Gnd and 5V pins of ESP8266 are connected to the screw terminals of the Motor driver L298N. Another Gnd from ESP8266 is connected to the Robotic arm. In Step down Voltage Board IN+ and IN- pins are connected to the VCC and Gnd of another lithium ion battery of 8V. The OUT+ and OUT- pins of board are connected to the Robotic Arm. Servo 1, Servo 2 and Servo 3 are connected to the Robotic arm.

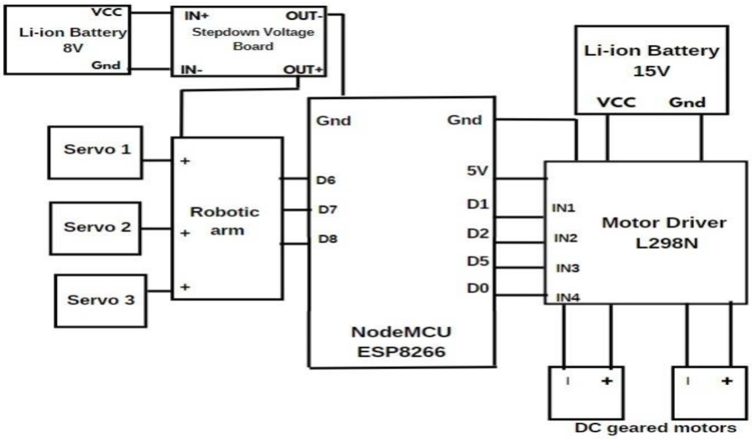

Fig4.1 Circuit diagram of Design and implementation of robot to assist bedridden person

The process is depicted in the flowchart shown in Fig.4.2.The commands are transmitted from the android app to the robot through the Wi-Fi module ESP8266. After receiving the commands the micro-controller controls the movements of the robot and the robotic arm accordingly. Then the signals are sent to the motor driver L298N which is used to control the speed and direction of the robot through DC geared motors of 100rpm. To power the Robot there are four Li-ion Batteries and to provide power to the Robotic Arm two Li-ion Batteries are used. To ensure the proper voltage is provided to servo motors for its movements Stepdown voltage board is used. The ESP8266 then controls the servo motors connected to the robotic arm for its movements. There are three servo motors such as Control to control the Robotic arm movements for Up and Down direction, Arm for front and back movements of the Robotic arm and the Claw for handling the objects. Based on the user commands the Robot moves in a particular direction picks up the objects and returns back to the desired place.

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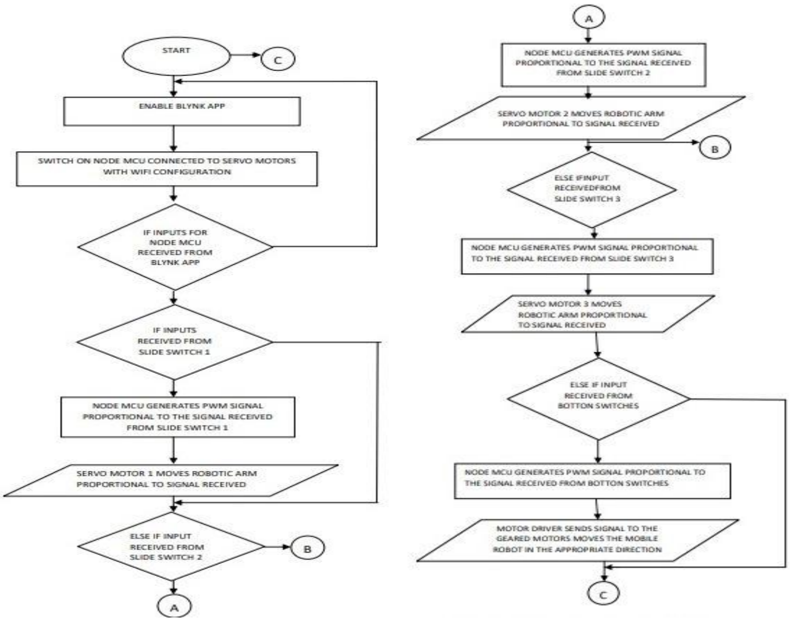

Fig4.2: Flowchart of the Design and implementation of robot to assist bedridden person

V.HARDWARE DESCRIPTION

The main hardware components used in this work are NodeMCU ESP8266, Motor driver L298N, Robotic arm with 3 DOF, Step-down voltage board, Servo motors, Li-ion batteries.

A. NodeMCU ESP8266

The NodeMCU is an open-source development environment based on the ESP8266 microcontroller chip. It includes two switches: a reset button for NodeMCU reset and a flash button for firmware upgrades. The board has a built-in LED indicator connected to the D0 pin. The ESP8266 features four power pins: one VIN input and three 3.3V output pins. It also provides three GND pins for grounding. Additionally, the board offers I2C pins for connecting I2C sensors and peripherals. The I2C interface can be programmed, with a maximum clock frequency of 100 kHz. The NodeMCU has 17 GPIO pins for various input/output operations.

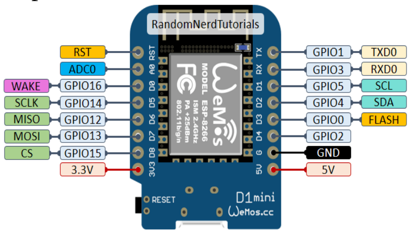

Fig5.1: NodeMCU ESP8266

B. Servo motor MG90s

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor, although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system. We are using MG90s servo motor.

Fig5.2: Servo motor MG90s

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C. Robotic arm

Robotic arms are motor-driven devices used to perform tasks quickly and accurately. They consist of joints, articulations, and manipulators, making them valuable in industries such as manufacturing and assembly. Controllers serve as the brains of robotic arms, enabling automatic or manual operation. The arm comprises the shoulder, elbow, and wrist, with the shoulder allowing forward, backward, and spinning movements. The elbow enables independent upper arm motion, and the wrist connects to end effectors functioning as the arm's hand. These end effectors typically have grippers that can open, close, and rotate, facilitating material handling.

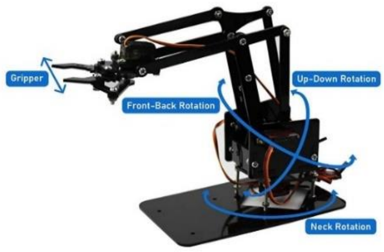

Fig5.3: Robotic arm with 3 DOF

D. Motor driver L298N

The L298N Motor Driver Module is a high-power motor driver used for driving DC and stepper motors. It can control up to 4 DC motors or 2 DC motors with direction and speed control. The module includes the L298 motor driver IC, 78M05 voltage regulator, resistors, capacitor, power LED, and a 5V jumper. The voltage regulator is enabled when the jumper is placed, allowing the internal circuitry to be powered. However, for power supplies greater than 12V, the jumper should be removed, and a separate 5V supply should be used. The L298N module is capable of controlling the speed and direction of two DC motors using PWM and H-Bridge techniques. It can also drive a stepper motor.

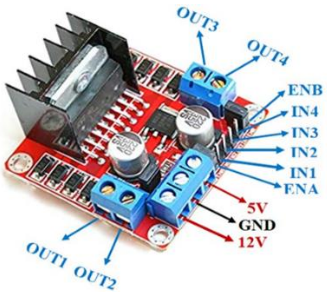

Fig5.4: Motor driver L298N

E. Step down voltage board

A step-down converter, also known as a buck converter, is a DC-to-DC converter that reduces voltage while increasing current from its input to output. It is a type of switched-mode power supply with high power efficiency compared to linear regulators. Buck converters are commonly used to convert higher voltages, like a computer's 12V supply, to lower voltages required by USB, DRAM, and CPUs. They typically consist of semiconductors (diode and transistor) and energy storage elements (capacitor and inductor). Filters are added to reduce voltage ripple. Buck converters operate at switching frequencies ranging from 100 kHz to a few MHz, allowing for smaller components but with increased efficiency loss due to frequent transistor switching. Here the Step down voltage board is used to convert the incoming 8V to 5.5V for servo motor movements.

Fig5.5: Step-down voltage board

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F. Li-ion battery

A lithium-ion (Li-ion) battery is a rechargeable battery that stores energy through the reversible reduction of lithium ions. It consists of a graphite anode, a metal oxide cathode, and a lithium salt electrolyte in an organic solvent. Li-ion batteries are widely used in portable consumer electronics, electric vehicles, grid-scale energy storage, and aerospace applications. They offer high energy density, low self-discharge, and no memory effect. However, they also have disadvantages, as seen in incidents like aircraft grounding and smartphone recalls. In this project 6 Li ion batteries of 3.7V each are used. A total of 15V is used to drive the mobile robot and 5.5V for movements of the robotic arm.

Fig5.6: Li ion battery

VI.SOFTWARE REQUIREMENTS

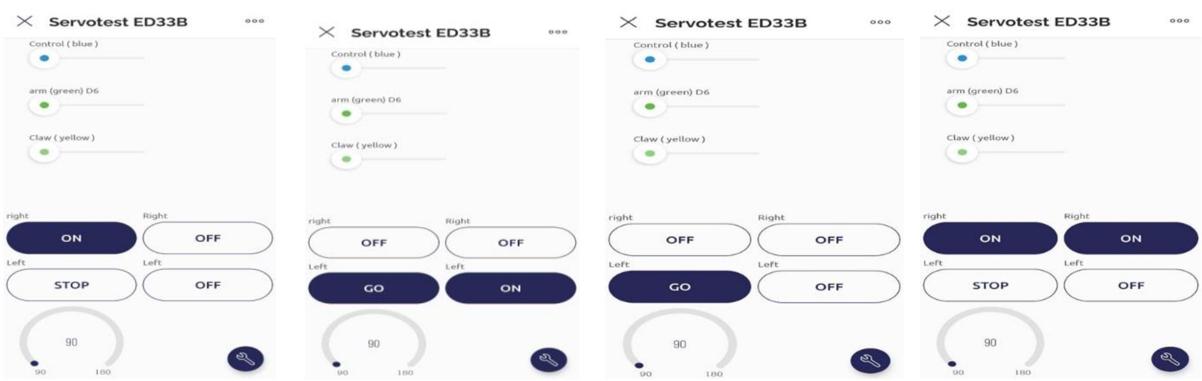
The software requirements for the system include the use of the Arduino Integrated Development Environment (IDE) and IoT Blynk app. The Arduino IDE is used for coding the NodeMCU ESP8266 to control the movement of Robot in different directions and the Robotic Arm movements using Embedded C programming.

A. **Arduino IDE**

Arduino IDE is an open-source software used for writing and compiling code for Arduino modules. It is user-friendly and accessible, even for beginners. The IDE is available for MAC, Windows, and Linux operating systems and utilizes the Java Platform for debugging, editing, and compiling code. Various Arduino modules, such as Arduino UNO, Mega, NANO, and Micro, feature a microcontroller that is programmed with code. The IDE's editor allows code creation, and the compiler transfers and uploads the code as a Hex File to the controller on the board. The IDE supports both C and C++ languages, making it versatile for programming Arduino modules. In this project we are coding with embedded C.

B. Blynk App

Blynk is an IoT platform for creating mobile applications to connect and control electronic devices over the internet. Engineers use Blynk to connect microcontrollers like Arduino, ESP8266, or single-board computers like Raspberry Pi to the internet via Wi-Fi, Ethernet, or cellular networks. Blynk Cloud is an open-source platform, and Blynk.Edgent is a packaged solution that simplifies device connectivity and provides advanced features without extensive coding. The Fig 6.1 shows the control using different switches in Bylnk app.



(a) (b) (c) (d)

Fig 6.1: (a) To move the Robot towards Right (b) To move the Robot Backward (c) To move the Robot towards Left (d) To move the Robot Forward

To control the robot with Blynk application;

- Download and install the Blynk app from Google or Apple app store.

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- After sign up click on 'New Project' to start your project. Now provide your project a name.
- Opt for your device from. Here, we are using ESP8266 Node MCU.
- While selecting your board opt for your association sort whether or not it's Wi-Fi or LAN or USB association.
- Select Wi-Fi association.

After these steps

- Click on 'Create' button to form your project.

As, the blank project opens;

- Add Widgets to it by clicking on Add button.
- Click on 'Button' to add 4 buttons to control the movements of robot.

Now in buttons settings provide a name to your button:

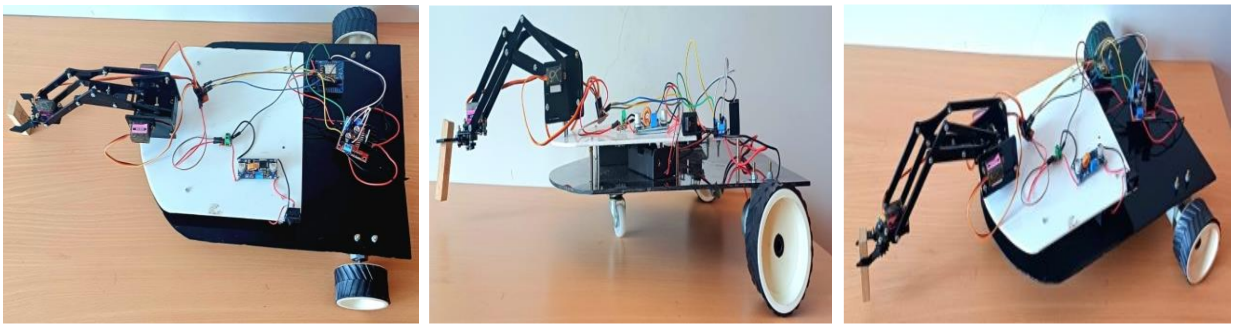
- Forward Left
- Forward Right
- Backward Left
- Backward Right

After assigning the pin number to the 'OUTPUT'. Also, give names to your On/Off labels.

- Now add 3 Sliders by clicking on 'sliders' to control the robotic arm.
- Slider 1-To control the arm to move the arm up and down motions.
- Slider 2-To control the arm in Forward and Backward directions.
- Slider 3-To control the Claw/Gripper for opening and closing.

VII.RESULTS AND DISCUSSION

The Robot is programmed to move in different directions like Left, Right, Forward and Backward based on the user's commands. The movement of robotic arm is enabled by controlling the servo motors. The movements of the robot are controlled through Blynk IoT app. Fig7.1 shows the different movements of the robot. The Robots after receiving the commands from the app moves towards the object, lifts the object through the robotic arm gripper. Then gets back to the user and places the object.



(a) (b) (c)

Fig7.1: (a) Robot approaching the object and opening of the gripper (b) Robot lifting the object and placing in new position (c) Robot placing the object and heading back

VIII.CONCLUSION

This project implements a 3 DOF robotic arm on a mobile robot. Hardware development involves controlling Servo motors and designing the arm. Software development includes creating controls on the Blynk app and programming the NodeMCU ESP8266. The arm is controlled via IoT using the Blynk app, allowing smart control from a computer or smartphone connected to the same network. This implementation enables global access to the robotic arm through the Internet of Things. While network-related delays can occur, practical test results demonstrate that wireless control connections reduce delay and improve stability.

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IX.FUTURE SCOPE

The future scope of this work would be to employ Raspberry platform, which would facilitate advanced logical and computation facility. The project can be integrated with IoT devices for creating a smart home system to monitor and send alerts for bedridden individuals. Artificial intelligence algorithms can be used to enhance the robotic arm's efficiency and adaptability to the user's needs.

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