WEARABLE ROBOTIC EXOSKELETON SYSTEM WITH INTEGRATED HEALTH MONITORING AND WEB DASHBOARD

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Introduction:
Mobility impairment from injury, aging, or neurological disorders greatly impacts the quality of life for many individuals. Traditional rehabilitation methods need constant supervision and are often hard to access. Wearable robotic exoskeletons offer mechanical support for human limbs, which helps improve mobility and rehabilitation. This project suggests a wearable robotic exoskeleton that includes real-time health monitoring and a web-based dashboard for remote tracking and analysis.

Objectives:

1. To design a wearable robotic exoskeleton for upper-limb assistance.
2. To provide controlled motorized actuation at elbow and wrist joints.
3. To integrate real-time blood pressure monitoring using oscillometric and coffless techniques.
4. To develop a standalone embedded system using ESP32 for control and processing.
5. To display real-time physiological and system data on OLED interface.
6. To ensure safe and reliable operation using embedded protection mechanisms.

Methodology:
Mechanical Design
•CAD modeling (Fusion 360 / Solid Works)
•Lightweight PLA/PETG structure with aluminum joints
Electrical Design
•ESP32 microcontroller
•Motor drivers (L298N / TB6612FNG / A4988)
•7.4V Li-ion battery with BMS
Sensor Integration
•Oscillometric BP measurement (cuff-based)
•PPG-based cuffless BP (MAX30102)

Firmware Development

•Real-time data acquisition and signal processing
•PWM-based motor control and direction control
•OLED interface using I2C communication

System Integration & Testing

•Integration of all modules into a standalone system
•BP validation with standard device
•Motor and system performance testing

Result and Conclusion:

The proposed wearable robotic exoskeleton system with integrated health monitoring and web dashboard presents an effective solution for assisting upper-limb movement while ensuring continuous physiological monitoring. By combining assistive robotics, biomedical sensing, and IoT-based remote tracking, the system enhances rehabilitation efficiency, patient safety, and accessibility. The integration of real-time data visualization through a web dashboard enables remote supervision and timely intervention. Overall, the project offers a cost-effective, scalable, and practical approach for applications in physiotherapy, assistive mobility, and healthcare monitoring.

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Future Scope:

The future scope of this project includes several enhancements to improve functionality, usability, and clinical applicability:

1. Integration with mobile applications and web dashboards for real-time remote monitoring, data logging, and analysis.

2. Implementation of EMG (Electromyography)-based control systems for intuitive and user-driven movement assistance.
3. Development of AI-based rehabilitation systems for adaptive therapy and predictive health analysis.
4. Expansion to multi-joint exoskeleton systems including shoulder and full upper-limb support.
5. Wireless communication using Bluetooth Low Energy (BLE) and IoT platforms for improved connectivity.
6. Clinical validation and certification for real-world healthcare and rehabilitation applications.