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Design and Development of Self Physiotherapy Arm

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Abstract: The design of an upper limb rehabilitation robot for post-stroke patients is considered a benchmark problem regarding improving functionality and ensuring better human–robot interaction (HRI). Existing upper limb robots perform either joint-based exercises (exoskeleton-type functionality) or end-point exercises (end-effector-type functionality). Patients may need both kinds of exercises, depending on the type, level, and degree of impairments.

This work focused on designing and developing a four-degrees-of-freedom (DoFs) upper-limb rehabilitation exoskeleton called 'self-exercising physiotherapy arm' that functions as both exoskeleton and end-effector types device. Furthermore, HRI can be improved by monitoring the interaction forces between the robot and the wearer. Existing upper limb robots lack the ability to monitor interaction forces during passive rehabilitation exercises; measuring upper arm forces is also absent in the existing devices.

This research work aimed to develop an innovative tensorized upper arm cuff to repetitive movements of upper arm. A control technique was implemented for both joint-based and end-point exercises.

Keywords: Wearable electronic devices
Sensors (e.g., motion, force, temperature, heart rate, SpO2, EMG)
Activity trackers
Microcontroller (e.g., ESP32, Arduino)
Assistive devices
Robotic-assisted devices / Exoskeletons

I. INTRODUCTION

The design of an upper limb rehabilitation arm for post-stroke patients is considered a benchmark problem regarding improving functionality and ensuring better human–robot interaction (HRI).Existing upper limb arm perform either joint-based exercises(exoskeletontype functionality) or end-point exercises (end-effector-type functionality). Patients may need both kinds of exercises, depending on the type, level, and degree of impairment

II. METHODOLOGY

1) Design and Fabrication of Mechanical Setup of Doctor and Patient Arm.
2) Circuit Development using Proteus Software.
3) Interfacing of Electrical Components with Arms.
4) Prototype Development.
5) Testing and Validation of the Arm.

III. LITERATURE SURVEY

1) Manoj Sivan, Justin Gallagher, Sophie Makower, David Keeling, BipinBhakta, Rory J. O'Connor, Martin Levesley-(2014) This Authors arewoks on this design. Home- grounded Computer supported Arm Rehabilitation(hCAAR)
2) Prem Kumar Mathavan Jeyabalan, Aravind Nehrujee, Samuel Elias, M. Magesh Kumar, S. Sujatha, Sivakumar Balasubramanian-(2023) This Authors are woks on this design. Design and Characterization of a tone- Aligning End- Effector

IV. PROPOSED SYSTEM

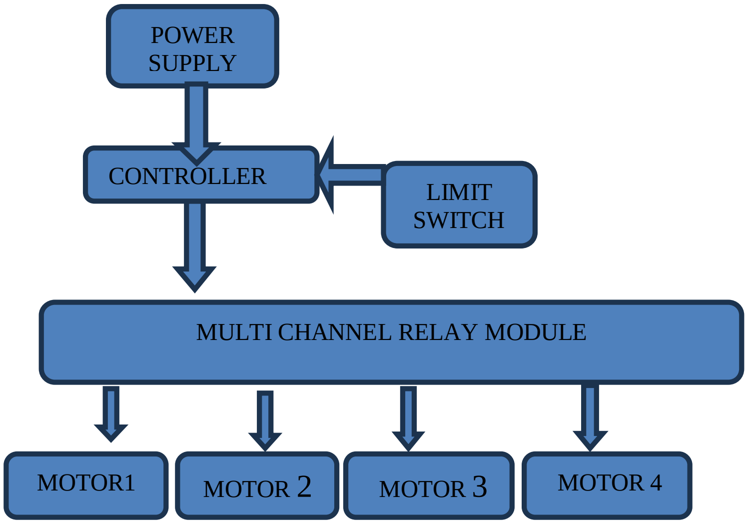

Fig. 1 Block Diagram

A. Working Principle

Here, in this work we are going to make self-physiotherapy arm. Which help people to do their exercises. Here we are focus on the paralysed person, ortho patients and huge IT working people. IT works do seating job or stressful work so out machine help them to in relief from stress. Here, we are going to design such arm which can allow maximum degrees of freedom to serve neediest. Also we always keep it mind that our design is flexible to all height and size peoples. By using our machine patients get covered faster than usual and also their stress level get normalised.

B. Construction

It will design in order to fix on the patient hand and also it can able to lift the patient hand. At each joint of the patient arm motor was fixed. Based on the signal transmitted from the controller motor was rotates and lifts the patient arm. Here we are giving 3-4 degree of freedom to our machine to serve our user. Here we are going to use MS pipe to structure the arm use aluminium links to connect sections. High torque gearmotor to give respective motion to structure and perform its job. All motors are powered with power source like Battery or SMPS. Number of fasteners are used to fix links and other parts with each other. Here, we are planning to use limit switches to limit swing of each degree of freedom.

V. FUTURE SCOPE

1) AI-Based Adaptive Therapy – Auto-adjust exercises based on progress.
2) AR/VR Integration – Immersive and motivating rehab exercises
3) Tele-Rehabilitation – Remote monitoring and therapy by doctors.
4) Advanced Sensors – EMG, grip force, and motion tracking for precise feedback.
5) Gamification & Mobile App – Interactive exercises and progress tracking

VI. CONCLUSION

This work presents the design and functionality of a motion-assisting device for arm exercises with portability characteristics, easy use even in home environments, and low cost, with features that are designed for use especially by elderly people not necessarily in rehabilitation therapies.

The device is based on the structure and functionality of a sensorized crank that can rotate in a range suitable for a user's conditions. The device can have servomotor-assisted operation or a crank movement driven solely by the user during operation. The major innovative feature can be recognized in the structural and functional simplicity designed for autonomous but also monitored use of arm exercises to train the the mobility of its articulations by elderly users.

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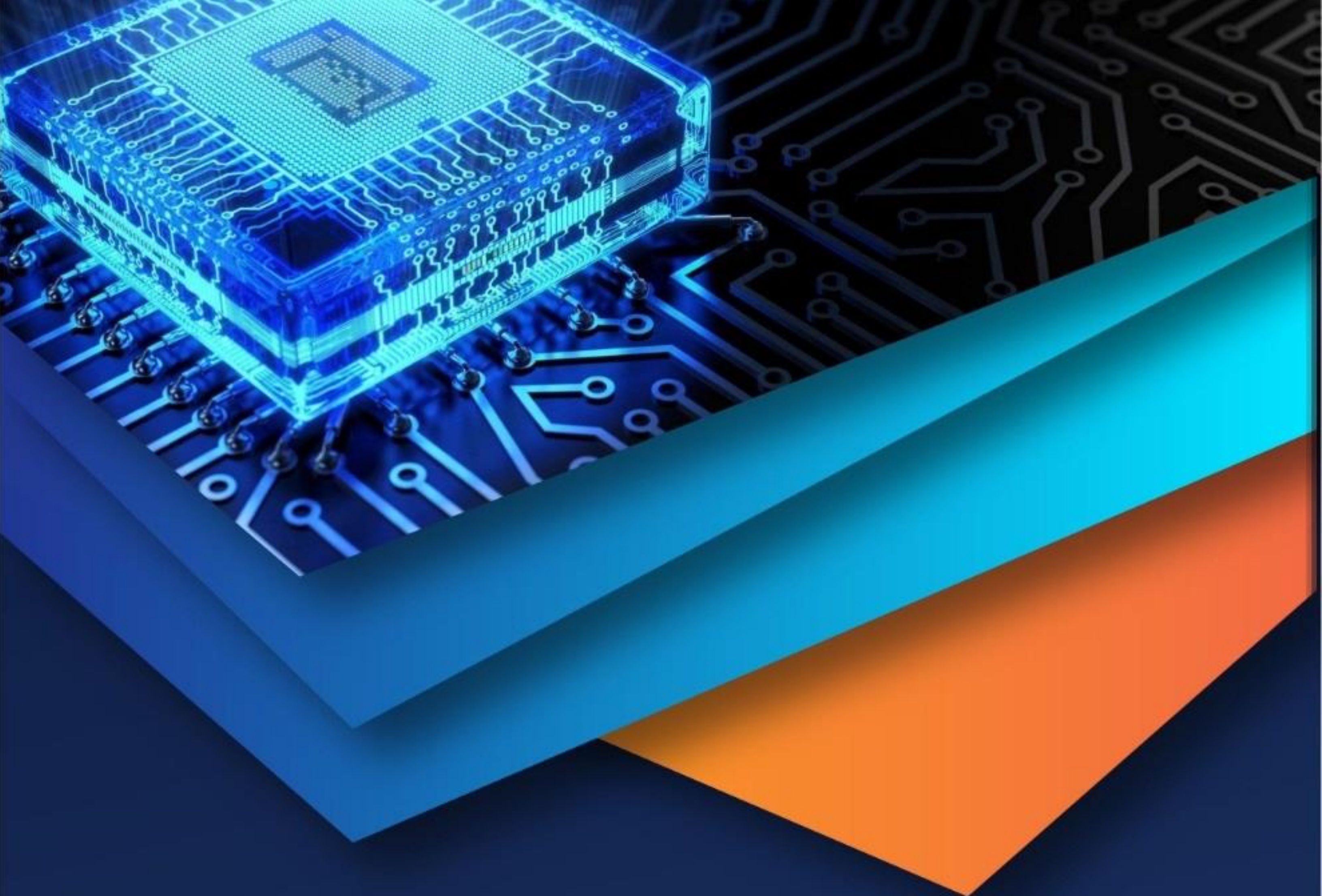

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