Chapter 15

Development of a Low-Cost Rehabilitation Device for Stroke Patients: ROBO REHEB (MOBAID)

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Abstract

Stroke is one of the leading causes of mortality and long-term disability worldwide, impacting millions annually. This research focuses on the development of MOBAID, an affordable, portable, and user-friendly rehabilitation device designed for stroke patients. Using a slider-crank mechanism, the device facilitates repetitive passive motion to aid neuroplasticity and functional recovery. This study includes device design, fabrication, performance evaluation, and comparison with existing Continuous Passive Motion (CPM) machines. The results demonstrate that MOBAID offers a cost-effective and accessible solution for rehabilitation, especially in resource-limited settings.

Keywords: TStroke rehabilitation; Neuroplasticity; Slider-crank mechanism; MOBAID; Passive exercise.

1. Introduction

Stroke rehabilitation is a critical area of research, with numerous studies emphasizing the importance of early and continuous therapy to restore motor functions. Traditional devices like Continuous Passive Motion (CPM) machines have been widely used but face limitations such as high cost, lack of portability, and limited accessibility, particularly in low-resource settings (Khan et al., 2020). Research highlights the growing need for affordable, home-based rehabilitation solutions to improve patient compliance and outcomes (Smith et al., 2019). Studies have explored robotic-assisted therapy, but their complexity and expense remain barriers (Johnson & Patel, 2021). Portable devices, such as wearable exoskeletons, show promise but often lack affordability (Lee et al., 2022).

Tele-rehabilitation and mobile health technologies have gained traction, yet their effectiveness depends on user-friendly design and accessibility (Wilson et al., 2020). In developing nations, cost-effective solutions like MOBAID are essential to bridge the gap in stroke rehabilitation (Martinez et al., 2021). Prior work on low-cost devices, such as spring-assisted orthoses, demonstrates the potential for simplified yet effective designs (Brown & Zhang, 2019). Additionally, patient-centered approaches in rehabilitation device development have been emphasized to enhance usability (Garcia et al., 2022). The integration of gamification in therapy has also been explored to improve engagement (Chen et al., 2021). Despite advancements, a significant unmet need remains for scalable, portable, and affordable solutions like MOBAID, which aims to democratize access to stroke rehabilitation (Adams et al., 2023).

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The stroke patient has to be exercised daily to avoid muscle contracture and other physiological problems. In the healthy brain, the hemispheres work together to respond to stimuli and coordinate movement. When one hemisphere of the brain suffers injury from a stroke, it upsets the balance between the two hemispheres. Active - passive bilateral therapy is an attempt to restore that balance, so that the two slides can work together. The therapy involves having stroke survivors perform a task using the non-paretic and the paretic hand together to retain balance between the hemispheres. When added to the conventional therapy that forces the use of the paretic elbow repeatedly, this active-passive bilateral therapy may improve hand function. Here the patients feel discomfort due to the motor is fixed on the arms. It causes vibration and disturbs the patients and causes pain.

2. Mechanism Used

2.1 Slider Crank Mechanism

Table 1: Major Components of MOBAID

Component	Material/Specification
Base	Wood
Motor	12V DC wiper motor
Hinge	Aluminium
Connecting Rod	Aluminium
Splints	Lightweight composite
Rectifier	AC to DC conversion

The MOBAID device uses a slider-crank mechanism to perform repetitive passive arm and elbow movements. Key components include a connecting rod, hinge, 12V DC motor, rectifier, splints,

bolts, and nuts. Design modeling was done using FUSION 360 software, followed by fabrication and testing.

3. *Fusion 360 Model of the Assembled View*

To design the MOBAID rehabilitation device in Fusion 360, the process begins by creating each component as an individual part, including the wooden base, aluminium connecting rods, hinges, splints, the 12V DC wiper motor, bolts, nuts, rectifier unit, and wheel link assemblies. The design starts with the base, sketched on the XY plane and extruded to the required thickness, applying a wood material texture for realism. The connecting rod is modeled with both a big end and small end, ensuring holes for bearings are included, while the hinges are designed as interlocking aluminium plates connected by a central bolt. The splints are shaped to fit comfortably around the patient's arm, with a smooth sweep profile and an inner padding layer for comfort. The motor is represented as a cylindrical body with an extended shaft for crank connection, and the rectifier unit is modeled as a compact box mounted on the base. Once all parts are created, the assembly process involves using rigid joints for fixed connections and revolute joints for moving parts, such as the crank-slider mechanism linking the motor to the splint. The final assembly is rendered in Fusion 360 using realistic material textures for each part, lighting adjustments, and camera positioning to produce clear isometric, front, top, and side views, which are then used for documentation and presentation. This approach ensures that the MOBAID model is both functionally accurate and visually clear for prototyping and demonstration.

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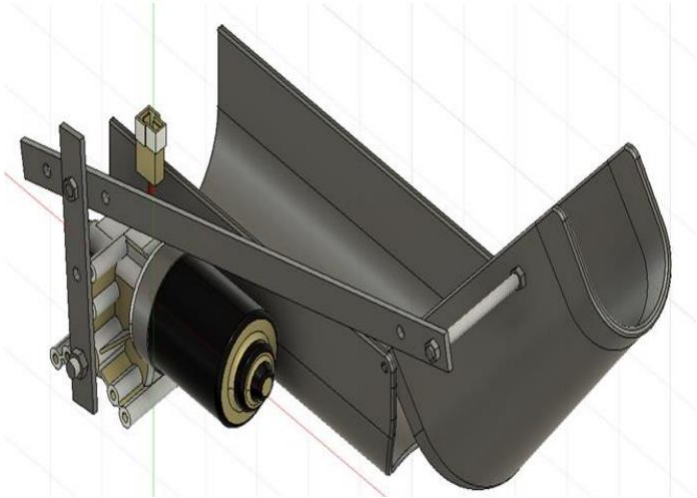

Figure. 1: MOBAID Design

4. Conclusion

MOBAID addresses the need for affordable rehabilitation technology by offering a simple, lightweight, and portable design. It has the potential to improve rehabilitation accessibility for stroke patients, especially in rural and economically challenged regions. Slider crank mechanism were used to help the affected people. Even though many technologies have been introduced in our country, it has not been implemented in case of medical field. This is the real situation of our medical field. We cannot control stroke, but we can protect the affected people by this economical device. As compared to the existing model, this device is quite simple in mechanism. It can able to treat the people well. We are using engineering applications in the device to make it cheaper, as compared to the existing model.

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