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Assistive and Rehabilitation Robots: Enhancing Lives Through Technology.

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Abstract: Robotics has evolved as a revolutionary technology in the field of healthcare and medical surgeries . Assistive and rehabilitation is the term that defines the tools which help people with disabilities , promoting independence .It also provides patients safety and significantly improving the precision of surgeries . Apart from surgeries it also plays a crucial role in diagnostics and therapy session and mostly in the rural areas & remote areas . Traditional medical practices were not precisely accurate to perform complex surgeries .By help of robotics it get easier to perform complex surgeries in a easy way and avoid the problems such as limited accuracy, surgeon fatigue ,lack of skilled professionals and risks during surgeries. It not only improves the healthcare but it also focuses on social awareness point of view .During pandemics robots were highly useful in medical healthcare .However it is not adopted widely because of the high cost ,lack of awareness and ethical concerns .it reduces the workload of doctors by helping them and to minimize human contact.it is essential to aware people abut the technology to have a better medical facilities. this study highlights that robotics in healthcare not only enhances medical performance but also contributes to social welfare by improving accessibility , safety and quality of life.

Keywords— healthcare robotics ,medical surgeries ,social awareness, assistive robotics and technology

1.INTRODUCTION

"Robotics and other combinations will make the world pretty fantastic compared with today"-Bill Gates

- Technology has progressively become a tool not only for ease but also for human health and promoting autonomy and independent living. Over the past few years , robotics has emerged as a key facilitator in rehabilitation and assistive care, helping individuals restore movement and perform daily activities. With the rise in population of elderly and people with physical disabilities, the demand for rehabilitation robotics is increasing . This paper discusses the role of robotics in rehabilitation, its benefits , limitations, and future prospects [1]

Assistive and Rehabilitation robots play a crucial role in helping people with disabilities , injuries or age-related issues. These robots assist with everyday tasks and help people recover mobility and allowing them to be more independent. Rehabilitation robots, like robotic exoskeletons and therapy machines, guide exercises that increase strength and make movement easier . Assistive robots helps with daily activities like eating, moving, or dressing, helping people do things on their own with less dependency on others. They are used in hospitals, rehabilitation centers, therapy centers and homes, making life easier and improve care for people

Even with the numerous benefits of assistive and rehabilitation robots , these robots struggle with problems like high costs, complex operation , and safety concerns. Most of these robots are only available in hospitals and rehab centers, and they often cannot meet the specific needs of every patient. Current research focuses on making these robots more affordable, smarter and adaptable to patients, improving human-robot interaction and allowing wider use. socially assistive robots [SAR]have seen significantly development .SARs are nothing it involves robots that help people through social interaction, motivation and companionship rather than just physical task aiming to improve engagement in therapy for conditions like stroke, autism or dementia by providing encouragement, feedback and sense of purpose bridging gaps in humans care .this robots have designed in multiple way to have personalized interaction and help people with disabilities . These robots provide real-time feedback, monitor progress, and provide personalized therapy in both clinical and home environments, enhancing scalability and efficacy in rehabilitation programs [22]. Overall, the use of SARs in rehabilitation indicates a promising advancement in healthcare and robotics, presenting innovative methods to

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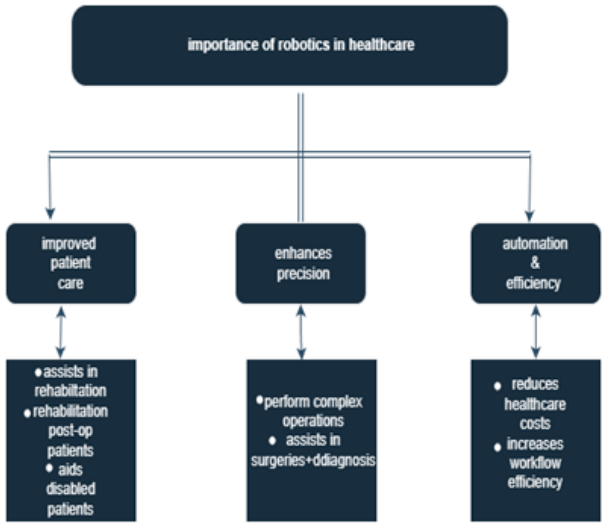
engage and assist patients while enhancing the adaptability and efficiency of rehabilitation.[5]

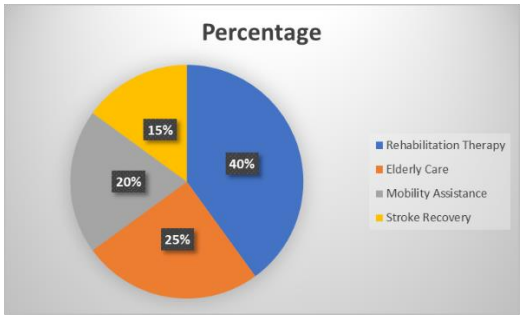
- Diagram :figure:1[source: self]



- Studying assistive and rehabilitation robots is important because they help people recover and become more independent ,who have disabilities or impairments. It has been shown that robot assisted therapy can offer steady, regulated , and repetitive movements that boost movement ability, muscle strength, and body coordination more effectively compared to traditional methods, facilitates neuroplastic modification, and contributing to improved effective outcomes in patients.[2]
- The study of assistive and rehabilitation robots contributes to society by strengthening healthcare, encouraging independent living and enriching daily life with physical disabilities. These technologies can reduce the workload of caretakers and medical experts ,by providing constant help and therapy to patients. Through ongoing research and development in this field, society can obtain more affordable, effective, and easy to use robotic systems ,so that more people can receive rehabilitation services . Eventually, this helps promote equal development for all, where people with disabilities can join more actively in education ,employment , everyday activities.
- The main objectives of this paper are:
- To study the concept of assistive rehabilitation in robotics.
- To enhanced the independence for users.
- To have a support for daily living.
- To analyze the application advantages of robotics in healthcare .

2.Literature review:

Many researches have highlighted the growing use of robotics in medical field. The World Health Organization (WHO) reports that 2.4 billion people worldwide could benefit from rehabilitation, with projections reaching 3.5 billion by 2050. Among these, stroke affects over 15 million people annually, with one-third requiring intensive rehabilitation, making it the leading cause of disability globally. Rehabilitation services are fundamental to achieving Sustainable Development Goal 3, particularly in low- and middle-income countries[3].



Researches have shown that rehabilitation robots develop patient recovery by providing repetitive and controlled movements .however this study emphasizes the benefits and application we are getting through rehabilitation.

3.METHODOLOGY

To ensure transparency and reproducibility in this system we review , end-effector robots, exoskeletons ,social robots, reinforcement learning ,etc. this systems are designed in such a manner so that it can provide a easy and fast learning by having advanced level of features that can help patients by guiding and supporting. algorithms allow robot to learn and adapt easily. The literature search was performed across multiple databases, including PubMed, IEEE Xplore, and Web of Science, to ensure comprehensive coverage of relevant studies published between 2008 and September 2024. The search

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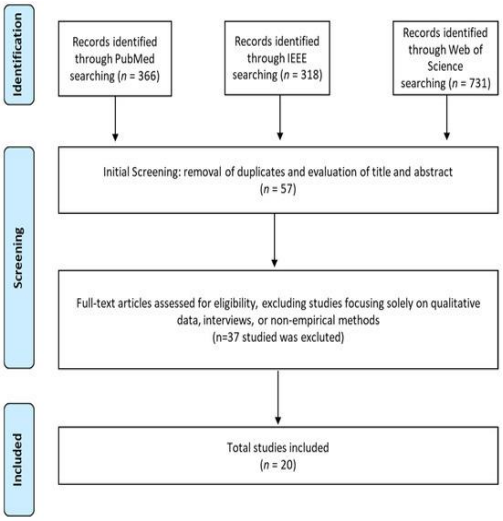
encompassed a range of conferences, journals, and technical publications. The database search query was designed around two key concepts: the intervention (Socially Assistive Robots, SARs) and the context (rehabilitation). Free-text terms and Boolean operators (AND, OR) were used to construct the search strategy.[4]



PRISMA flow diagram.[2]

4.RESULT& ANALYSIS

According to recent research paper it is observed that there has been a steady increase in research work. The studies conclude the use of rehabilitation for treating patients & helping them in their every day life by providing precise consistent and engaging therapy by helping patients with motor and cognitive improving independence and reducing care giver burden, tough challenges remain in cost . Most studies address the use of robots in rehabilitation therapy , mobility assistance and elderly care by showcasing their importance in enhancing patient healing & self-reliance . in recent years there has been a rapid evolution in the field of robot-aided rehabilitation .there are multiple types of robots used in healthcare like: exoskeleton robots, therapy robots, assistive service robots, wearable robots .

- Exoskeleton robots: Its primary application is to gait training & mobility and its key benefit is to enhance Walking ability .
- Therapy robots: Its primary application is physical rehabilitation ,key benefit is to provide repetitive motion .
- Assistive service robots :Its primary application is to have daily activity support , key benefit is to increase independence .
- Wearable robots :Its primary application is muscle assistance ,key benefit reduces physical effort .

Despite benefits there are certain challenges :

- Limited availability in rural areas
- High initial cost and maintenance
- Ethical & safety concerns
- Need for proper training of users & professionals

5.DISCUSSION

Human-robot interaction plays a crucial role in assistive & rehabilitation .
Many studies have highlighted the importance and uses of robotics in the healthcare.
Robots are transferring the manufacturing trends in market by providing robots that can help elderly patients having a better life Experience .robotics education and research now have a great impression on journal conference .the rapid increase of robotics in many sectors have strongly expanded the opportunities for robot graduates .advancement in Ai ,Machine learning and IOT's are expected to make this system more intelligent and affordable .home-based robots may become more common , allowing patients to receive therapy at home. It reduces the workload on for healthcare professions , improved quality of life, faster recovery of patients , enhanced patient independence ,improve accuracy & consistency in therapy .it must emphasize that the task in rehabilitation robotics is not only to develop more complex devices but also to reach an agreement on the methods used in trials and evaluation techniques .[6]. Rehabilitation not only benefit group of elderly or disabled but even average people who have medical issues .new efficient techniques , partially applying mechanical & robotic-aid can reduce the cost and ensure the public healthcare system.

6.CONCLUSION

The concept of rehabilitation come into existence in the ancient times .
Many industrialized countries are suffering from the limited resources for healthcare and ever-increasing number of disabled and elderly population. A practical way to address this issue is to apply more advanced and reliable robotic technologies for the healthcare industry. Existing assistive technologies are unsatisfactory in meeting personal needs and fulfilling the required functions at a reasonable cost. Any innovation to improve the capability of personalization or reduce the ratio of

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price and performance will stimulate the applications of robotic technologies in healthcare significantly.[7]

It is clear that robotic technology no has become an important tool for people with physical disabilities , neuro-logical disorders and age-related mobility issues .in future we can say that this technologies ‘ll be affordable , user friendly and effective .it ’ll not wrong to say that assistive & rehabilitation holds a promising future with more advanced technologies for healthcare system .Current research conclude that the robot-assisted technologies most effective when embedded rehabilitation . studies have showed that regular use of this can lead to major improvements in motor function . the robot human interaction can encourage people with disabilities & motivate them. The therapy session could be an exciting activity for patients to have faster recovery .

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Figures:[1] self made

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