

Topic: Robotic Arm for people using wheelchairs
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First Draft

When I was still an undergraduate, I once helped a graduate student design a robotic hand, so I believe that the robotic arm is not entirely unfamiliar to me, which is why I chose this topic. At the same time, I believe that modern society needs more robots to assist people. With the global aging population increasing, wheelchairs have become very important, not to mention for people with disabilities who also need them. Wheelchairs have become a necessity in their lives, a part of their existence, but not everyone can use a wheelchair perfectly. This is where the robotic arm comes in to help them, making their lives more convenient. I think this is the main reason why this project was established.

After reviewing some online papers, I learned that Jaco has done a wonderful job on it. It has become the biggest robotic arm wheelchairs maker in the world. They use carbon fiber on the product so that it can be lightweight. And it can lift up to 3.3 pounds by its robotic arms. That is what I have learned from this project.

ChatGPT generation:

1. Target Users:

1.1. Individuals with Mobility Impairments:

- **Primary Users:** People with **severe mobility limitations** due to spinal cord injuries, muscular dystrophy, cerebral palsy, or multiple sclerosis.
- **Need:** These users may find it difficult or impossible to perform tasks like grabbing objects, opening doors, or reaching for items without assistance. A robotic arm can help perform these everyday tasks independently, improving autonomy and reducing reliance on caregivers.
- **Applications:**
 - Assisting with personal care tasks (e.g., feeding, brushing teeth).
 - Accessing and manipulating items in difficult-to-reach locations (shelves, tables).
 - Assisting with housework (e.g., picking up objects, turning lights on/off).

1.2. Elderly Individuals:

- **Primary Users:** Older adults who experience a decline in motor skills or physical strength, especially those who rely on wheelchairs due to conditions like arthritis, osteoporosis, or post-surgery recovery.
- **Need:** As the global population ages, more elderly individuals will require mobility aids. Robotic arms can help elderly users with daily activities, reducing the physical effort needed and increasing their ability to remain independent at home.
- **Applications:**
 - Picking up dropped objects, opening containers, or helping with light meal preparation.
 - Managing light housework tasks or hobbies (e.g., gardening, crafting).

- Assisting with medication management (e.g., retrieving pills or bottles).

1.3. People with Temporary Disabilities:

- **Primary Users:** People who have sustained **temporary disabilities** such as arm or hand injuries, and who may need a robotic arm for a limited period.
- **Need:** During rehabilitation, a robotic arm could assist in managing everyday tasks that are difficult to perform with one arm, allowing users to maintain independence and continue daily activities.
- **Applications:**
 - Assisting with recovery tasks, such as exercising injured limbs in physical therapy.
 - Enabling users to maintain productivity in professional or academic environments.

1.4. Individuals in Specialized Environments (Hospitals, Care Facilities):

- **Primary Users:** Patients in **hospitals or care facilities** who require long-term care and use wheelchairs.
- **Need:** These individuals may need assistance with more complex tasks in their care environments, such as accessing personal items or using communication devices. A robotic arm can reduce the burden on caregivers and allow users to take on more activities independently.
- **Applications:**
 - Helping users access medical devices, medication, or personal items.
 - Assisting with rehabilitation exercises or physical therapy routines.
 - Reducing caregiver workload by automating certain routine tasks.

2. Applications:

2.1. Personal Assistance in Daily Life:

- **Task Automation:** The robotic arm can be used for tasks such as opening doors, picking up dropped objects, handling household tools (like a remote control or smartphone), or even pouring drinks. It can greatly improve the convenience of daily activities and provide users with greater control over their environments.
- **Health Management:** The robotic arm could assist users with taking medication, managing health devices, or checking their physical well-being (such as monitoring vitals or assisting with mobility exercises).

2.2. Professional and Educational Settings:

- **Assisting with Work:** For individuals in wheelchairs who are employed in office or educational settings, a robotic arm can assist with tasks such as typing, operating machinery, or handling office supplies. This increases inclusivity and enables people with limited mobility to fully participate in professional environments.
- **Academic Support:** In educational environments, students using wheelchairs could use a robotic arm for note-taking, managing books, and interacting with lab equipment, increasing their ability to engage in a wide range of learning activities.

2.3. Social and Recreational Activities:

- **Enhanced Participation:** The robotic arm can enable users to participate in recreational activities such as sports (e.g., adapted table tennis or chess), cooking, or playing musical instruments.
- **Creative Endeavors:** Artists or musicians who use wheelchairs could use the robotic arm for precision tasks in painting, sculpting, or playing instruments, which may otherwise be challenging due to physical limitations.

2.4. Public Spaces and Smart Environments:

- **Accessibility in Public Spaces:** In public areas such as libraries, museums, or stores, robotic arms integrated with wheelchairs could help users interact with information kiosks, browse shelves, or operate ATMs. This could make public spaces more accessible and user-friendly for people with mobility challenges.
- **Smart Home Integration:** The robotic arm could be integrated with **smart home systems**, allowing users to control devices (lights, thermostats, appliances) through voice commands or mobile applications. This integration would enhance the overall experience and create an environment where users can manage their surroundings with minimal physical effort.

2.5. Rehabilitation and Therapy:

- **Therapeutic Aid:** In rehab settings, robotic arms can aid users in performing **therapeutic exercises**. They could provide gentle assistance for muscle recovery exercises or assist in post-surgery recovery tasks by helping the patient regain strength and flexibility.
- **Customizable Exercises:** The arm can be programmed to assist with specific repetitive movements, which is essential for individuals undergoing physical therapy or occupational therapy.

My analysis:

Through the content generated by GPT, I've learned a lot. First of all, GPT's analysis of the application of robotic arms is very thorough. Although my general direction and perspective are similar to the results analyzed by the GPT language model, GPT can provide more detailed and specific insights, allowing clients to better understand the functions and extensive applications of robotic arms. At the same time, I was pleasantly surprised by GPT's ability to expand on the topic, as it carefully elaborated on the uses of robotic arms in everyday life. The examples used by GPT are closely related to real-life scenarios, which makes people naturally reflect on whether robotic arms could contribute to healthier living and improve quality of life.

However, I believe GPT has one point that is not well addressed. It suggests that robotic arms can be used in hospitals or care facilities, but in reality, this is impractical. If highly precise robotic arms were introduced into simple care settings, patients or caregivers would likely need to perform many complex operations, which would unnecessarily increase the workload. This demonstrates that while GPT offers many seemingly perfect answers, there are still some flaws in its reasoning.

In the next steps, I will continue to research how to maximize the precision of robotic arms. If a highly precise robotic arm can be controlled with a simple operation method, it could then be widely used. By reviewing some papers and articles, I learned that the precision of robotic arms is basically a degree of freedom. With a higher degree of freedom, the arms could control more joints and do more

movements. However, it will cost too much to achieve a better performance. My goal in the future is to find a balance between a high degree of freedom that could meet everyone's needs with a low cost. Additionally, I will research the materials and construction techniques of the robotic arm, as cost is also a very important part of a product.

Reading papers:

Robotics: Modelling, Planning and Control by Bruno Siciliano et al.

Modern Robotics: Mechanics, Planning, and Control by Kevin M. Lynch and Frank C. Park

“Robust Control of Robot Manipulators with Joint Flexibility”

"Task-Space Control of Robotic Manipulators"

Human-Robot Interaction: An Introduction by Dautenhahn K.

Telerobotics, Automation, and Human Supervisory Control by Thomas B. Sheridan