JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

# Design & Fabrication of Voice Operated Motorised Exo Skeleton Arm

Mr. M. PeeruNaik*, M. Tech, (Ph.D.)
Asst. prof, Dept of Mechanical Engineering
Srinivasa Ramanujan Institute of Technology
Anantapur, India
*

N. Manohar
Dept of Mechanical Engineering
Srinivasa Ramanujan Institute of Technology
Anantapur, India

S.MD. Arshad Hasan
Dept of Mechanical Engineering
Srinivasa Ramanujan Institute of Technology
Anantapur, India

Y. Kishore Kumar Reddy
Dept of Mechanical Engineering
Srinivasa Ramanujan Institute of Technology
Anantapur, India

A. Naveen Kumar
Dept of Mechanical Engineering
Srinivasa Ramanujan Institute of Technology
Anantapur, India

S. Aquib Basha
Dept of Mechanical Engineering
Srinivasa Ramanujan Institute of Technology
Anantapur, India

***Abstract:*** The exoskeleton is becoming really important for humans in many ways, like helping with strength, muscle training, and recovery after injuries. Scientists are working on making exoskeletons smarter by combining human thinking with machine power, making them even better at helping people. One big goal is to design prosthetic arms that work just like real arms, with the right speed and strength. Right now, prosthetic arms are more like tools you can put on and take off. The challenge is making them lighter and more powerful, and finding better ways to control them. Exoskeletons are also useful for people who've lost strength after something like a stroke. This project looks at different types of exoskeletons for arms, focusing on how they help with strength and recovery. It breaks down the structure of the exoskeletons based on how many ways they can move, like at the shoulder, elbow, wrist, and hand.

**KEYWORDS**: Arduino Microcontroller, DC motors, Bluetooth Module, Battery, Exoskeleton arm, Arduino IDE.

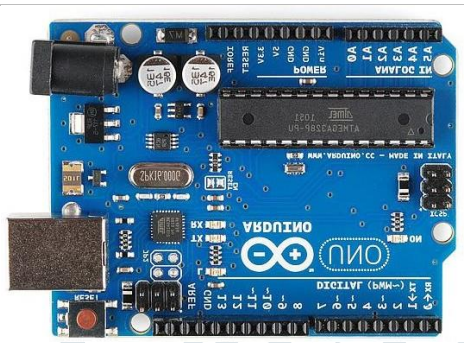
## I. INTRODUCTION

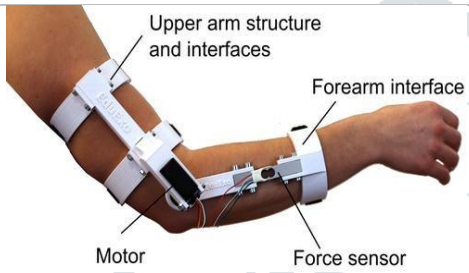
Our project focuses on developing a voice-operated motorized exoskeleton arm, primarily aimed at assisting physically handicapped individuals. The current landscape of upper extremity prosthetics research aims for fully functioning prosthetic arms capable of coordinating speed and strength responses. However, existing prosthetic arms are often viewed as tools rather than limb replacements, facing limitations in weight, power, and control complexity. While pneumatic prostheses offer supplementary functions, they struggle to replicate natural arm movements due to control challenges. Current motorized prosthetic arms typically have single degrees of freedom, relying heavily on vision for feedback and employing switches, pneumatic actuators, and control valves for operation. In contrast, exoskeleton suits worn by operators in industries provide a solution for efficient material handling, reducing fatigue, and enhancing strength. Our proposed design distinguishes itself by opting for a power assist exoskeleton over more costly power amplification devices. Utilizing McKibben air muscles as the primary power actuator, our

system achieves reduced power consumption and a higher power-to-weight ratio compared to alternatives. This lightweight yet powerful exoskeleton arm aims to address challenges related to industrial injury and physical disability by providing enhanced strength and support. Designed for portability and ease of use, it boasts an aluminium framework segmented into shoulder, elbow,and wrist sections, with embedded hardware components including an Arduino microcontroller, relay, fasteners, lead acid battery,DC geared motor, and Bluetooth module for seamless integration and control.

## II. MATERIALS & METHODOLOGY:

### 1. Construction of Exo Skeleton Arm:

| S. No | Components | Images | Description |
|---|---|---|---|
| 1. | **Arduino Microcontroller** |  | The Arduino microcontroller is an open-source electronics platform based on easy-to-use hardware and software, with various models offering different specifications for input/output, memory, and processing capabilities. |
| 2. | **Bluetooth Module** |  | The HC-05 is a commonly used Bluetooth module for wireless communication in electronic projects. It operates as a serial port over Bluetooth, allowing devices to communicate wirelessly. It's often used in Arduino projects and other microcontroller-based systems for tasks like remote control, data logging, and sensor data transmission. If you have any specific questions about using the HC-05 module, feel free to ask |
| 3. | **DC Motor** |  | A DC motor is an electro-mechanical device that converts electrical energy into mechanical motion, characterized by specifications such as voltage, current, power rating, speed, torque, and physical dimensions. |

| | | | |
|---|---|---|---|
| **4.** | **Battery** |   | A battery is a device that stores chemical energy and converts it into electrical energy through a controlled chemical reaction. It typically consists of one or more electrochemical cells, each composed of two electrodes (an anode and a cathode) separated by an electrolyte. When a circuit is connected to the battery, electrons flow from the negative terminal (anode) to the positive terminal (cathode), generating an electric current. Batteries come in various types, including alkaline, lithium-ion, lead-acid, and nickel-metal hydride, each with different characteristics suited for specific applications. |
| **5.** | **ExoSkeleton Arm** |   | An exoskeleton arm is a robotic device worn on the outside of the body that enhances the strength and mobility of the user's arm. It can assist with tasks that require lifting heavy objects or provide support for individuals with limited arm function. It's like having a super-powered arm. |
| **6.** | **Arduino IDE** |   | The Arduino Integrated Development Environment (IDE) is a software platform used to write, compile, and upload code to Arduino microcontroller boards. It provides a user-friendly interface for programming Arduino projects, with features such as syntax highlighting, code completion, and a serial monitor for debugging. The IDE supports a simplified version of C++ called the Arduino programming language, making it accessible to beginners and experienced developers alike. |

**2. Working Principle:**

- **Voice Input:** The user provides voice commands through a microphone connected to a voice recognition module.
- **Voice Recognition Module:** The voice recognition module processes the incoming voice commands and converts them into digital signals corresponding to specific actions.
- **Microcontroller:** The digital output from the voice recognition module is sent to the microcontroller. The microcontroller, such as an Arduino, serves as the brain of the system. It interprets the digital signals and generates control signals to operate the motors of the robotic arm.
- **Motor Drivers:** The control signals from the microcontroller are fed into motor drivers. These motor drivers provide additional power to the motors of the robotic arm and control their direction of rotation.
- **Bluetooth-Arduino Android Application:** Once the system is implemented, users can issue voice commands to the exoskeleton arm through a Bluetooth-Arduino Android application. When the Bluetooth module HC-05 is activated, it sends a signal to the Arduino microcontroller.
- **Arduino Microcontroller:** Upon receiving the signal from the HC-05 transmitter, the Arduino microcontroller processes the command and activates the relay accordingly.
- **Relay:** The relay acts as a switch, activating the motors in the elbow and wrist of the exoskeleton arm based on the received voice commands. It helps in controlling the power supply to the motors.

- **External Power Supply:** To power the system, an external 5V power supply is required. This power supply is typically provided through a battery to ensure mobility and independence for the user.
- **Motorized Movement:** Upon receiving the appropriate command, the motors in the elbow and wrist of the exoskeleton arm start working, allowing the user to perform tasks such as lifting, gripping, or reaching, depending on the specific movements programmed into the system.

The voice-operated motorized exoskeleton arm represents a significant advancement in assistive technology, offering a user-friendly and efficient solution for individuals with physical disabilities. By utilizing voice commands, users can easily control the arm's movements, allowing them to perform daily tasks with increased autonomy and ease. This technology not only enhances independence but also promotes a sense of empowerment and dignity for users, enabling them to navigate their environment and accomplish tasks with greater confidence and efficiency. Overall, the exoskeleton arm serves as a valuable tool for improving the quality of life for those with mobility impairments, providing newfound freedom and capability in everyday activities.

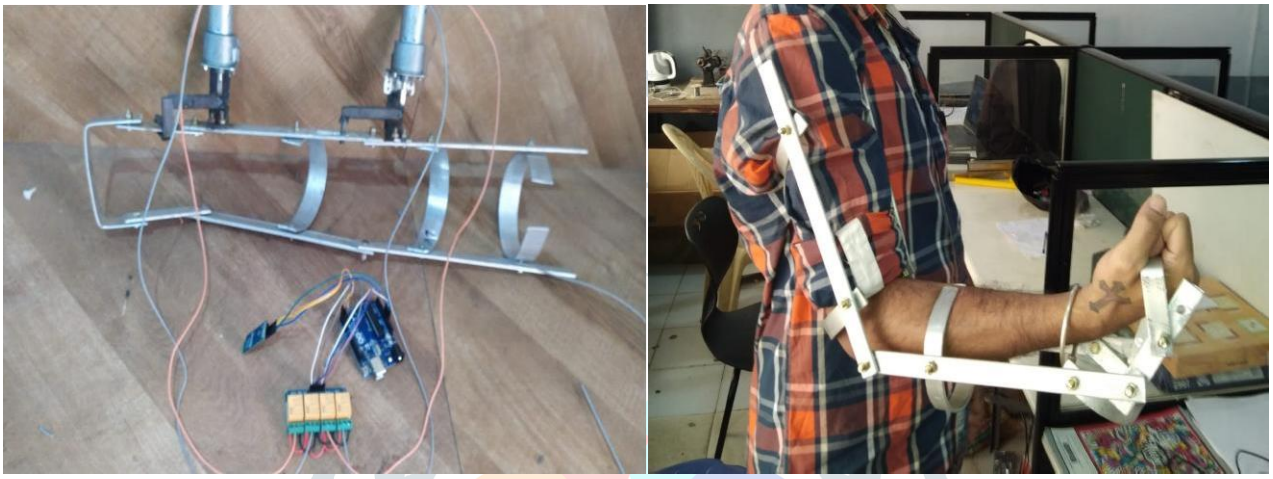


Fig1: Voice Operated Motorised Exo Skeleton Arm

**3. Benefits Of Present System:**

The design and fabrication of a voice-operated motorized exoskeleton arm comes with several benefits. Let me share a few of them with you:

- **Accessibility**: Allows individuals with limited mobility or disabilities to operate the exoskeleton using voice commands, promoting independence and mobility.
- **User-Friendly Interface**: Voice commands provide a natural and intuitive interface, reducing the need for complex manual controls and making the exoskeleton easier to use.
- **Hands-Free Operation:** Users can control the exoskeleton without the need for manual input, allowing them to perform tasks or navigate environments while keeping their hands free**.**
- **Efficiency**: Voice commands can streamline operation, allowing users to quickly and efficiently control the exoskeleton without the need to physically interact with buttons or switches.
- **Safety:** Voice control minimizes the risk of accidents or errors that may occur when using manual controls, enhancing overall safety for the user.
- **Customization**: Voice-operated systems can be customized to recognize individual voices and commands, providing a personalized user experience and accommodating specific needs or preferences**.**

The fabrication of a voice-operated motorized exoskeleton arm offers several advantages. It not only saves time and effort but also reduces costs, all while promoting environmental sustainability. This innovative solution represents a smart and convenient approach to ensuring the effective maintenance of arm lifting.

**III. CONCLUSION**

In conclusion, the survey underscores significant advancements in the field of voice-operated motorized exoskeleton arms, particularly in recent decades, with many innovations demonstrated within controlled environments. However, challenges persist in transitioning these technologies for everyday use and outdoor applications. Addressing these challenges necessitates collaborative efforts across disciplines such as medical technology, biomechanics, engineering, and product development. Key

areas requiring attention include power source technologies and reliable wireless communication for enhanced outdoor usability. The portability of pneumatic hand exoskeleton systems remains a formidable development challenge. Additionally, there is a growing consensus on the importance of considering the entire upper extremity system and even exploring whole-body suit exoskeletons in future research. Regardless of the number of degrees of freedom incorporated, exoskeleton technology holds promise for benefiting individuals with physical challenges. Further research is warranted, particularly in refining exoskeleton control systems to deepen our understanding and optimize the functionality of exoskeleton arms.

## IV. ACKNOWLEDGEMENT

We extend our sincere gratitude to all the authors whose research papers served as invaluable sources of knowledge and inspiration during the writing of this paper. Their contributions have greatly enriched our understanding and will undoubtedly guide future research endeavours in this field.

## V. REFERENCES

[1] "Hybrid Step Motors", Pacific Scientific, 2000. [Online]. Available: https://www.artisantg.com/info/pacific_scientific_step_motors_datasheet.pdf. [Accessed: 17- Mar- 2017].

[2] T. Skvarenina, The Power Electronics Handbook, 1st ed. Boca Raton, Fla.: CRC Press, 2002.

[3] "LT1680 High Power DC/DC Step-Up Controller", Linear Technology, 1997. [Online]. Available: http://cds.linear.com/docs/en/datasheet/1680fa.pdf. [Accessed: 17- Mar- 2017].

[4] G. Pratt and M. Williamson, “Series elastic actuators,” Proceedings 1995 IEEE/RSJ InternationalConference on Intelligent Robots and Systems. Human Robot Interaction and Cooperative Robots.

[5] C. De Luca, "Surface Electromyography: Detection and Recording", Delsys Inc., 2002. [Online]. Available: https://www.delsys.com/Attachments_pdf/WP_SEMGintro.pdf. [Accessed: 17- Mar- 2017].

[6] "3M™ Red Dot™ Pediatric Monitoring Electrodes with 3M™ Micropore™ Tape Backing 2248-50 |3M United States", 3M. [Online]. Available: http://www.3m.com/3M/en_US/company-us/all-3m-products/~/3M-Red-Dot-Pediatric-Monitoring-Electr odes-with-3M-Micropore-Tape-Backing-2248-50?N=5002385+3294796421&rt=rud. [Accessed: 17- Mar- 2017].

[7] “Safety Standard Recognized, 900 Series, Encapsulated, AC Type, 5 400 VAC/13 250 VAC(Industrial Grade)", Kemet, 2017. [Online]. Available: http://www.kemet.com/Lists/ProductCatalog.