International Journal of Research Publication and Reviews, Vol 5, no 4, pp 2438-2443 April 2024

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Implementation of Controllable Netmover Arm for Lifting and Placing the Objects Using Wireless Mode.

Ravi Kumar M[1], Lokesha A M [2], Akshay Kashyap S[3], Arun Kumar N [4] Chethan Gowda V N[5],and Dileep Kumar N[6]

[1,2]Assistant Professor, Department of Electronics and Communication Engineering, Cambridge Institute of Technology (CI Tech), Bengaluru, India
[3,4,5] Student, Department of Electronics and Communication Engineering, CITech, Bengaluru, India

ABSTRACT

This paper focuses on the development of a versatile robotic arm with advanced functionalities, aiming to enhance automation in diverse industries. Integrating precision engineering and smart control systems, the robotic arm demonstrates agility and adaptability for various tasks, such as assembly, pick-and-place operations, and intricate manipulations. Employing state-of-the-art sensors and machine learning algorithms, the system ensures optimal performance and safety. This project contributes to the evolution of robotic technology, addressing real-world challenges and fostering efficiency in industrial processes.

Developing a cutting-edge robotic arm is the primary objective of this project, aimed at revolutionizing automation across industries. Leveraging advanced materials and sophisticated control algorithms, the robotic arm exhibits unparalleled precision and adaptability. Integrating innovative sensing technologies and machine learning, it excels in complex tasks, offering a transformative solution for assembly lines, manufacturing, and research applications. This project underscores the pivotal role of robotics in shaping the future of automation, showcasing a versatile and intelligent robotic arm that pushes the boundaries of technological innovation.

Keywords: Robotic arm, Automation, Precision engineering, Machine learning algorithms, Industrial processes

Introduction

The advent of robotic technology has ushered in a new era of automation, revolutionizing industries across the globe. Among the most pivotal advancements in this realm is the development of robotic arms — versatile mechanical systems designed to mimic and augment human arm movements. These robotic appendages have become integral components in diverse fields, ranging from manufacturing and assembly to healthcare and research.

The aim of this project is to delve into the intricacies of designing and implementing a state-of-the-art robotic arm, exploring its potential applications and the transformative impact it can have on various sectors. As technology continues to advance, the demand for more sophisticated and adaptable robotic systems grows, prompting the need for innovative solutions to address complex challenges.This introductory exploration will provide an overview of the significance of robotic arms in modern industries, highlighting their role in enhancing efficiency, precision, and safety. By examining the evolution of robotic arms, from early iterations to the latest cutting-edge models, we can gain insight into the trajectory of this technology and its potential future developments.

In the pages that follow, we will delve into the fundamental principles behind robotic arm design, investigating the materials, sensors, and control systems that contribute to their functionality. Moreover, we will explore the diverse applications of robotic arms, showcasing their versatility in addressing tasks ranging from simple pick-and-place operations to intricate surgical procedures. The convergence of mechanical engineering, artificial intelligence, and sensor technology in the development of these robotic arms underscores the interdisciplinary nature of this field and its transformative impact on the way we approach automation. As we embark on this exploration, it becomes evident that the robotic arm is not merely a mechanical device but a catalyst for innovation, poised to redefine the boundaries of what is possible in the realm of automation. This project aims to contribute to this ongoing narrative, pushing the envelope of robotic arm capabilities and uncovering new opportunities for their integration into various industries.

Continuing with our exploration, it is essential to recognize the key drivers behind the increasing adoption of robotic arms in diverse applications. One of the primary motivations is the pursuit of increased efficiency in manufacturing processes. Robotic arms excel in repetitive and precision-based tasks, allowing for faster production cycles and minimizing errors. This not only enhances productivity but also contributes to cost-effectiveness, making robotic arms an attractive solution for industries seeking to optimize their operations.

Furthermore, the adaptability of robotic arms plays a crucial role in their widespread acceptance. These systems can be easily reprogrammed and reconfigured to perform different tasks, making them versatile assets in dynamic production environments. As industries evolve and diversify, the ability to swiftly adapt to changing requirements becomes a valuable asset, and robotic arms provide a scalable and flexible solution to meet these demands.

The integration of advanced sensors and artificial intelligence (AI) technologies further enhances the capabilities of robotic arms. Sensing technologies enable these robotic systems to perceive and respond to their environment in real-time, facilitating precise movements and ensuring safety in collaborative settings. Machine learning algorithms empower robotic arms with the ability to learn and optimize their performance over time, allowing for continuous improvement and adaptation to evolving tasks.

In the medical field, robotic arms have revolutionized surgical procedures, enabling minimally invasive interventions with enhanced precision. This not only benefits patients through reduced recovery times but also empowers surgeons with improved control and visibility during delicate operations. The intersection of robotics and healthcare exemplifies the transformative potential of these technologies in enhancing human capabilities and improving outcomes.

As we delve deeper into the technical aspects of robotic arm design, we will explore the materials and engineering principles that underpin their construction. Additionally, we will discuss the pivotal role of control systems in orchestrating the complex movements of robotic arms, ensuring synchronization and accuracy in their operations.

Methodology

In this system, two distinct circuits play crucial roles in enabling communication between sensors and actuators. The first circuit, dedicated to transmission, functions as the transmitter responsible for conveying sensor values. This initial phase involves the transfer of data, often representing environmental or operational conditions, from the sensors to the receiving end. On the receiving side, the second circuit comes into play, serving as the receiver. Here, the transmitted sensor values are decoded and utilized to control actuators. The actuators, driven by the information received, respond by executing specific actions or adjustments. This collaborative interplay between the transmitting and receiving circuits forms a closed-loop system, allowing for real-time monitoring and control based on the sensor data, ultimately facilitating automated and responsive functionalities in various applications.

The methodology for developing a robotic arm involves a structured and iterative process. The initial phase encompasses conceptualization, where the specific requirements and functionalities of the robotic arm are defined. In this case, the focus is on creating a system that allows a doctor to remotely manipulate a robotic arm for medical purposes using a specialized glove. The choice of sensors, such as the ADXL345 Accelerometer and Flex sensor, is crucial to enable intuitive and precise control over the robotic arm's movements link. The incorporation of a 1602 (16*2) LCD Display and a 4*4 Matrix Keypad on both ends enhances user interaction and facilitates the configuration of IP addresses. The use of smartphones for video calls introduces a visual element, allowing the doctor to have real-time visual contact with the remote environment, thereby improving the overall teleoperation experience.

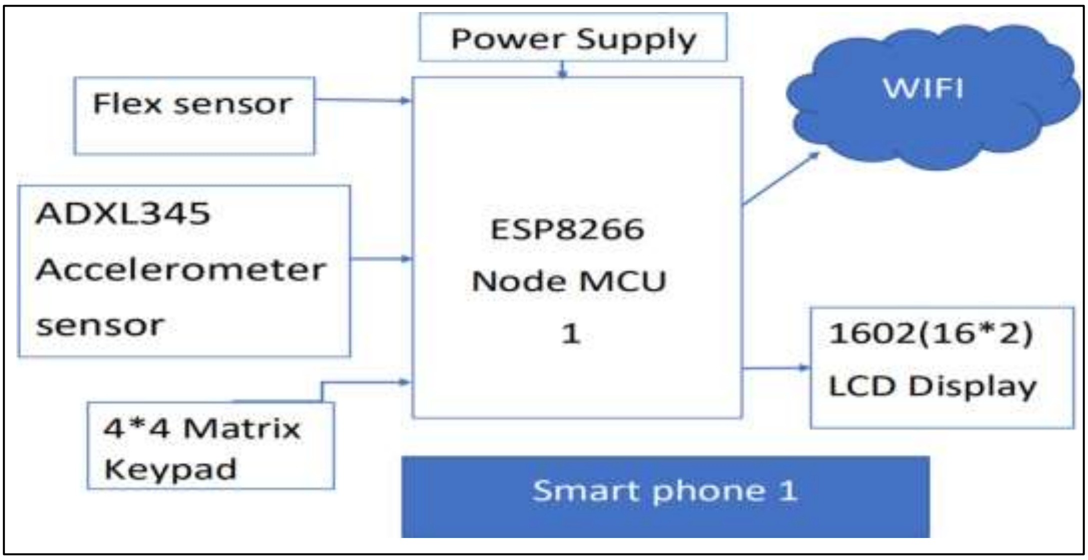

Fig 1: Robot Transmittor

Once the design is finalized, the implementation phase involves assembling the hardware, programming the microcontrollers, and testing the system's functionality. Iterative testing and refinement are crucial to ensure the reliability and responsiveness of the robotic arm. Finally, the deployment and operationalization phase involves integrating the system into the medical environment, providing necessary training, and ensuring the seamless integration of the robotic arm into the medical workflow.

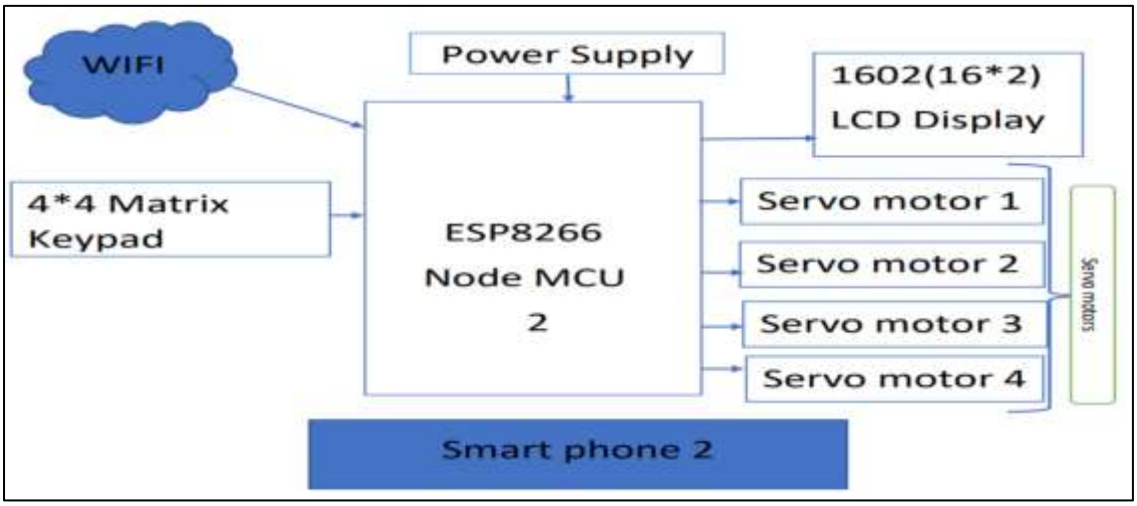

Fig. 2: Wireless Receiver

According to the block diagram depicted in Figure 3.2, the system comprises two distinct circuits, each serving a specific function. The first circuit, designated as the transmission setup, is responsible for sending signals, while the second circuit is designed for receiving the transmitted signal and generating a suitable output. In both the transmitter and receiver modules, the ESP8266 Node MCU plays a central role, functioning as the brain of the system. The ESP8266 Node MCU is a microcontroller board equipped with a built-in WIFI module, making it a pivotal component for signal processing and communication. Acting as both the receiver of input signals and a WIFI transceiver, the ESP8266 Node MCU receives input data, processes it, and subsequently transmits the appropriate output signal. This integrated functionality makes the ESP8266 Node MCU a versatile and essential element in the overall system, enabling seamless wireless communication and control between the transmitter and receiver circuits. The robotic arm uses number of servo motors as actuator to grab objects and to move in different axis to control the robotic arm.

The doctor employs a specialized glove housing the transmitter circuit in the development of a robotic arm system. Within the transmitter circuit, an ADXL345 Accelerometer is utilized to provide axial direction to servo motors, while a Flex sensor instructs the servo motor to grasp with specific pressure. To execute these functions, a microcontroller and WIFI transceiver are essential components, and for this purpose, two ESP8266 Node MCU modules are employed—one at the transmitter and the other at the receiver. Both ends of the system integrate a 1602 (16*2) LCD Display and a 4*4 Matrix Keypad, facilitating the connection to the respective IP addresses of the ESP8266 Node MCU boards. Additionally, smartphones are incorporated for video calls, enabling visual contact on both ends of the system. The methodology for developing this robotic arm follows a systematic approach encompassing various stages, from the initial conceptualization to the practical implementation of the design. This involves careful consideration of components such as accelerometers and flex sensors, as well as the integration of microcontrollers and WIFI transceivers for seamless communication between the transmitter and receiver circuits. The inclusion of LCD displays, keypads, and smartphones enhances the user interface and overall functionality of the robotic arm system.

Literature review

1. **Mohamad Khairi Ishak1 , Muhammad Izzat Roslan1 and Khairol Anuar Ishak2 1School of Electrical and Electronic Engineering, University Sains Malaysia, Engineering Campus, 14300, Penang, Malaysia. 2School of Business Management, UUM College of Business, university Utara Malaysia, Sintok,06010, Kedah, Malaysia. khairiishak@usm.my**

This paper presents the process of developing a controller for a robotic arm that is built through the Internet of Things (IoT). The direction of the robotic arm can be monitored and controlled using internet facilities. The Raspberry Pi board is utilized in this project for the robotic arm controller as well as the web server system. The robotic arm comprises four servo motors and each of the servo motors is assigned with a single pulse width modulation (PWM) output that can be individually controlled. The controller system is implemented on Raspberry Pi board using Python 2.7 programming language. Node- Red is used as a web server in this project to communicate with the web browser through TCP/HTTP. Hence, this allows the user to access the web browser using computer or smartphones. In addition, it enables the monitoring and controlling of the robotic arm direction as well as performing pick and place task similar to the manufacturing industry. The results of this study are verified through practical test implementation. Index Terms—Raspberry Pi; Robotic Arm; Web Server; Internet of Things

2. **Aravind Raj D., Dinesh Kumar G International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-7 Issue- 6, August 2018**

This paper present the research activities and the results obtained to controlling the robotic hand using man wearied robotic gloves. The practical setup is obtained with the help of robotic arm. This is paper updates the existing system, in which short distance controlling can be done. The model developed will be of minimum cost and can be used in variety of places and also in various applications. The interest in robotics has been steadily increasing in recent times and research on robots for new and diverse fields is ongoing. This project discusses the current research and development on robot actuator, which is used to control the joints of robots, and focuses on developing more efficient technology for joint control, as compared with the current technologies. It also aims to find means to apply the abovementioned technology to diverse industrial fields. We found that easy and effective control of actuators could be achieved by using IOT network, which were widely being used on wireless communications. It is proved that the developed wireless actuator could be used for easy control of various robot joints. Keywords: IOT Network, The Practical Setup Is Obtained With The Help Of Robotic Arm.

3. **1B.Sundari, 2 Sivaguru.S 1Assistant Professor, Jayam College of Engineering & Technology, Anna University, Tamilnadu, India. 1E 1Assistant Professor, AVS College of Technology, Anna University, Tamilnadu, India. SSRG International Journal of Electronics and Communication Engineering (SSRG – IJECE) – Volume 5 Issue 8 – Aug 2018**

This paper has design and development of a robotic arm manipulator using Internet of things with low cost. The robotic arm has controlled by wirelessly is very helpful for broad range of applications which ranging from medical fields, automations in industries. With the popularity and widespread use of internet, it becomes an easy task for anyone to control and monitor the robots from a remote end. In this project, a robotic arm is designed to be controlled by an authorized person at any time and from any place using the web technology. With a web server, it becomes easy to control devices from a remote site. A web server is set up on the hardware side of Robotic Arm. From the client side, the control signals are sent over internet medium to a remote end to control the robotic arm. Keywords: Human interface, Tele-robotics, alarm manipulation, Robotics, IOT, Remote end, Internet.

4. **Authors like Craig, J.J. (Introduction to Robotics: Mechanics and Control) and Siciliano, B., & Khatib, O. (Springer Handbook of Robotics) delve into the mechanical design and kinematics of robotic arms.** These foundational works explore the principles governing the movement and geometry of robotic arms, laying the groundwork for subsequent research.

5. **Research by Cacace, J., et al. (Human–Robot Collaboration: A Survey) and Bicchi, A., & Sorrentino, F. (Robotics in the 21st Century: Challenges and Promises)** explores the emerging field of collaborative robotics. These studies discuss the challenges and opportunities in designing robotic arms that can work alongside humans safely and efficiently.

This literature survey underscores the interdisciplinary nature of robotic arms, bridging mechanical engineering, control theory, artificial intelligence, and application-specific domains. As the field continues to evolve, staying abreast of these foundational works and emerging trends is essential for researchers, engineers, and practitioners aiming to contribute to the forefront of robotic arm technology.

The benefits of this project is as mentioned below:

[1] Controlled By Wireless Mode

[2] No App Installation Required

[3] Using Socket Ip For Transmission Of Signal

[4] Smartphone Control

[5] No Internet Required

[6] Helps in automation of the routine general works

Summary of Literature review

TABLE: Survey summary of serdes implementation

Serial No.	**Author & Year**	**Description**	**Objective**	**Methodology**	**Speed & Power**	**Problems**
1	Zhang et al., 2023	Investigating novel actuators for enhanced robotic arm control	To explore the use of advanced actuators for improved control	Experimental study comparing traditional actuators with newly developed ones in terms of control precision and efficiency	Increased speed and reduced power consumption	Limited availability of novel actuators and potential compatibility issues with existing systems
		Analyzing the impact of reinforceme nt learning	To assess the effectiveness of reinforcement	Comparative study between traditional control methods and		Training time and computational complexity

2	Lee & Park, 2023	in robotic arm manipulatio n	learning techniques in robotic manipulation tasks	reinforcement learning algorithms for robotic arm manipulation	Improved speed and adaptability	associated with reinforcement learning algorithms
3	Wang et al., 2024	Investigating the integration of tactile sensors for object recognition in robotic arms	To explore the use of tactile sensors for object recognition tasks	Experimental study evaluating the performance of robotic arms equipped with tactile sensors in object recognition tasks	Improved accuracy and adaptability	Calibration and noise interference with tactile sensors
4	Chen et al., 2024	Examining the use of soft robotics for flexible robotic arm design	To assess the benefits of soft robotics in designing flexible robotic arms	Comparative study between traditional rigid robotic arms and soft robotic arms in terms of flexibility and adaptability	Increased flexibility and safety	Limited load-bearing capacity and durability of soft robotic materials
5	Gupta et al., 2023	Exploring the integration of vision systems for object tracking in robotic arms	To investigate the use of computer vision for real-time object tracking	Experimental study evaluating the performance of vision-based tracking algorithms in robotic arm manipulation tasks	Improved object tracking and manipulation accuracy	Computational overhead and environmental lighting conditions affecting vision system performance

Conclusion & future scope

In conclusion, the ubiquitous presence and diverse applications of robotic arms underscore their pivotal role in shaping the landscape of modern automation. From manufacturing floors to surgical theaters, these mechanical marvels have become indispensable components, driving efficiency, precision, and safety across a spectrum of industries.

The journey through the exploration of robotic arms has revealed the intricate synergy between mechanical design, control systems, artificial intelligence, and sensor technologies. The evolution from traditional industrial robots to collaborative and adaptive robotic systems reflects an ongoing commitment to enhancing human-machine interaction and expanding the boundaries of automation.

The impact of robotic arms on manufacturing processes has been profound, leading to increased production rates, improved product quality, and a reduction in manual labor. In the medical field, they have ushered in a new era of minimally invasive surgeries, offering unprecedented precision and control to healthcare professionals.

Looking ahead, the trajectory of robotic arms points toward continued innovation. Emerging technologies, such as soft robotics and advanced haptic feedback, promise to further enhance the adaptability and capabilities of these systems. As the fourth industrial revolution unfolds, the integration of robotic arms into smart factories and interconnected systems exemplifies their role in the era of Industry 4.0.

However, this transformative technology also brings forth ethical considerations, particularly concerning job displacement and the need for workforce upskilling. Striking a balance between the benefits of automation and the socio-economic implications remains a critical aspect of harnessing the full potential of robotic arms responsibly.

In essence, the world of robotic arms is a testament to human ingenuity and our relentless pursuit of innovation. Whether reaching into the depths of space or delicately navigating the intricacies of human anatomy, robotic arms continue to redefine possibilities and pave the way for a future where man and machine collaborate harmoniously to usher in a new era of productivity, safety, and technological advancement.

REFERENCES

1. Mohamad Khairi Ishak1 , Muhammad Izzat Roslan1 and Khairol Anuar Ishak2 1School of Electrical and Electronic Engineering, University Sains Malaysia, Engineering Campus, 14300, Penang, Malaysia. 2School of Business Management, UUM College of Business, university Utara Malaysia, Sintok,06010, Kedah, Malaysia. khairiishak@usm.my

2. Aravind Raj D., Dinesh Kumar G International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-7 Issue- 6, August 2018

3. 1B.Sundari, 2 Sivaguru.S 1Assistant Professor, Jayam College of Engineering & Technology, Anna University, Tamilnadu, India. 1E 1Assistant Professor, AVS College of Technology, Anna University, Tamilnadu, India. SSRG International Journal of Electronics and Communication Engineering (SSRG – IJECE) – Volume 5 Issue 8 – Aug 2018

4. Kobayashi, Y.; Gyoda, M.; Tabata, T.; Kuno, Y.; Yamazaki, K.; Shibuya, M.; Seki, Y. Assisted-care robot dealing with multiple requests in multi-party settings. In Proceedings of the 6th International Conference on Human-Robot Interaction—HRI'11; ACM Press: Lausanne, Switzerland, 2011; p. 167.