IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.301

Volume 3, Issue 4, June 2023

Internet of Things (IOT) based Robotic Arm

Om Sudam Patil[1], Prasad Dinkar Patil[2], Pratik Pravin Patel[3], Aman Sanjay Pawar[4], Mrs. J.G. Sulakshane[5]

[1,2,3,4]Students of Final Year Diploma of Department of Electronics & Telecommunication

[5]Lecturer, Department of Electronics & Telecommunication

Guru Gobind Singh Polytechnic, Nashik, India

Abstract: *We examined mechanism design and kinematic simulation of a new six degrees of freedom (DOF) Internet of Things (IOT) robotic arm with rotational joints and a linkage motion mechanism. In the design, a parallel linkage mechanism, accompanied by an additional set of bevel gears, was used to create the desired motion for all six links along with transfer of all actuators to the robot's base to reduce the mass of most of the arms. These changes resulted in reduction of the torque required for joints 1, 2, and 3. Using this parallel mechanism ensures dependence to motion links and creates a special case for the control of the robot and more rigidity against unwanted movement. Initially, we examined mechanism design methods for a parallel linkage mechanism and considered methods for application in an operational robot. In the next step, we determined the kinematic relationships that were established between the robot's actuators and joints spaces due to the use of this mechanism. Then, we developed an example of the robot's function in a performance simulation. The simulation results indicated that the mechanism and controller performance were acceptable.*

Keywords: Robotic Arm, 6 DOF, Kinematic Simulation.

I. INTRODUCTION

The robots used in most industries are 6 DOF Internet of Things (IOT) Based robotic arms, because they have the ability to position and rotate for their end effectors with high accuracy. In the past few decades, various mechanisms have been considered to provide 6 degrees of freedom for the motion of robotic arms, with the robotic arms with rotational joints and wrists with intersecting axes being used most often. Currently, most industries use such robots. Due to the intersecting axes of the robot's wrist, the entrance rotational axes for joints 4, 5, and 6 must be set up by a rectifier mechanism, such that it is placed in arm 3. Therefore, the motors that move these three joints must be placed beside each other at the beginning of arm 3.

The motors of the other three joints (joints 1, 2, and 3) are attached directly to the rotational part of the joints. Now, it is obvious that, in the usual mechanism of such robots, the motors of joints 1, 2 and 3 must move motors of next joints as well as the links after them. Therefore, moving the motors of these joints requires more torque than was required to move just the structure of the links of the robot. In previous years, different mechanisms have been suggested to improve the performance of such robots' systems by decreasing the power required by their motors. Some of these mechanisms that have been used are the cable mechanism [2, 3, 4], and the belt mechanism [5, 6, 7], which have similar functions, as well as hydraulic [8, 9, 10], pneumatic [11, 12, 13], and linkage [14, 15, 16], mechanisms. These mechanisms can cause motions to occur by transferring the robots' motors (such as cable, belt, and linkage mechanisms) or their main source producing power (such as hydraulic and pneumatic mechanisms) to the robot's base, thereby transferring motion from these motors to the rotational axes of the related joints.

II. PROBLEM DEFINATION

Design a robotic arm that can be controlled via IoT technology, including sensors, actuators, and a microcontroller. Develop software that allows the robotic arm to respond to real-time data input from the environment, such as temperature, humidity, and light levels.

Implement remote control capabilities to allow the user to control the robotic arm from anywhere with an internet connection. Test the robotic arm in a variety of scenarios to evaluate its performance and identify areas for

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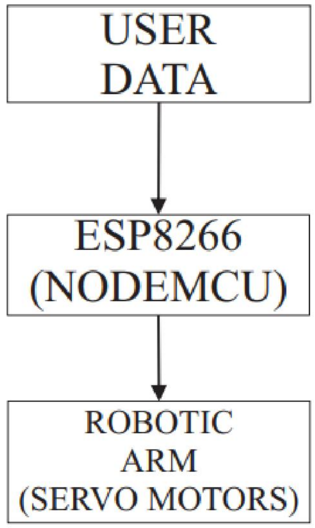
improvement. Provide documentation and a user manual for the robotic arm to allow for easy replication and usage by others.

III. BLOCK DIAGRAM OF THE ROBOT



IV. WORKING OF ROBOTIC ARM

The working of The Internet of things (IoT) based robotic arm involves several components, including the arm structure, actuators, sensors, and a control system.

The arm structure consists of six joints that allow the arm to move and manipulate objects in three-dimensional space. Each joint is connected to an actuator, which can be an electric motor, hydraulic piston, or pneumatic cylinder. The actuators are controlled by a central control system that receives input from sensors to determine the arm's position and orientation.

Sensors play a crucial role in the operation of the robotic arm, as they provide feedback to the control system about the arm's position, velocity, and acceleration. This feedback is used to adjust the movements of the arm to ensure accuracy and precision.

The control system of the 6 DOF robotic arm includes software and hardware components that enable the arm to perform specific tasks. The software component involves programming the arm to execute specific movements and sequences of actions, while the hardware component includes electronic components such as motors, actuators, and sensors.

In operation, the control system sends signals to the actuators, which move the joints of the arm. The sensors then provide feedback to the control system about the arm's position, velocity, and acceleration, allowing the control system to adjust the arm's movements in real-time. This feedback loop enables the robotic arm to perform complex tasks with a high degree of precision and accuracy.

Overall, the working of a 6 DOF robotic arm involves the integration of several components to create a highly versatile and precise machine capable of performing a wide range of tasks.

V. ADVANTAGES OF ROBOTIC ARM

The Internet of things (IOT) Based robotic arm offers numerous advantages over traditional manufacturing and material handling processes. These advantages include:

- Increased efficiency and productivity: A 6 DOF robotic arm can perform repetitive tasks quickly and accurately, resulting in increased efficiency and productivity. This can help reduce production time and costs while improving product quality.

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- Versatility: The ability to move in six different directions allows the 6 DOF robotic arm to perform a wide range of tasks, making it highly versatile. It can handle a variety of objects, from small electronic components to large pieces of machinery.

- Precision and accuracy: The use of sensors and a control system allows the 6 DOF robotic arm to perform tasks with a high degree of precision and accuracy. This can help reduce errors and waste, resulting in higher quality products.

- Improved safety: The use of a robotic arm can help reduce the risk of workplace injuries, as it can perform dangerous or repetitive tasks that may be hazardous for human workers.

- Cost savings: Although the initial cost of a 6 DOF robotic arm can be high, it can result in long-term cost savings by reducing labor costs, improving productivity, and reducing errors and waste.

VI. APPLICATIONS

- Can be used in Manufacturing and industrial settings to automate repetitive tasks as pick & Place, Material Handling and Packaging.
- Can be used as smart home assistance Various household task as cleaning organizing and Fetching Object
- Can be used Healthcare and Rehabilitation in healthcare facilities to assist with patient care, such as helping disabled or elderly individuals with activities of daily living.

VII. LITERATURE SURVEY

"Design and Implementation of IoT-Based Robotic Arm for Smart Warehouse Management": This paper presents the design and implementation of an IoT-based robotic arm system for smart warehouse management. The system utilizes sensors and a camera to locate and pick up items, and then transport them to the desired location.

"IoT-Based Robotic Arm Control for Industrial Automation": This paper describes an IoT-based robotic arm control system for industrial automation. The system uses a Raspberry Pi and an Arduino to control the robotic arm and collect data from various sensors.

"Real-Time IoT-Based Control of a Robotic Arm": This paper presents a real-time IoT-based control system for a robotic arm. The system uses a microcontroller to control the robotic arm and a Raspberry Pi to collect data from various sensors.

"IoT-Based Robotic Arm for Assistance of Elderly and Disabled Persons": This paper proposes an IoT-based robotic arm system to assist elderly and disabled persons in performing daily tasks. The system utilizes sensors to detect the user's actions and provide assistance accordingly.

"IoT-Based Robotic Arm Control for Precision Agriculture": This paper presents an IoT-based robotic arm control system for precision agriculture. The system uses sensors to detect the location of plants and a robotic arm to perform precise operations, such as planting and harvesting.

"IoT-Based Robotic Arm for Disaster Response": This paper proposes an IoT-based robotic arm system for disaster response. The system utilizes sensors and a camera to locate and rescue people in disaster-stricken areas.

"IoT-Based Robotic Arm for Surgical Applications": This paper describes an IoT-based robotic arm system for surgical applications. The system utilizes sensors and a camera to perform precise surgical procedures.

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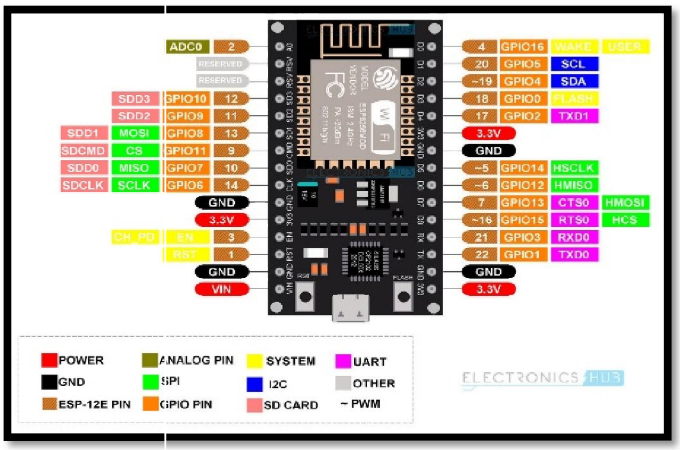
VIII. SYSTEM REQUIREMENTS

The six DOF robot arm consists of several key components, including motors, sensors, controllers, and end-effectors. The motors are responsible for powering the movement of the joints, while the sensors provide feedback on the position and movement of the robot arm. The controller serves as the brain of the robot, receiving inputs from the sensors and sending commands to the motors. Finally, the end effector is the tool or attachment at the end of the robot arm that performs the specific task.

HARDWARE USED:

1.Processor - ESP8266



2.MG996r Servo Motor

3.SG 90 Servo Motor

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4.Power Supply – 5V 5Amp power supply

IX. ALGORITHMS

- Hashing & Mapping: A cryptographic hash function (CHF)is a mathematical algorithm that maps data of an arbitrary size (often called the "message") to a bit array of a fixed size (the "hash value", "hash", or "message digest").

- It is a one-way function, that is, a function for which it is practically infeasible to invert or reverse the computation. Ideally, the only way to find a message that produces a given hash is to attempt a brute-force search of possible inputs to see if they produce a match, or use a rainbow table of matched hashes. Cryptographic hash functions are a basic tool of modern cryptography.

X. CONCLUSION

The use of IoT technology has enabled the robotic arm to be controlled remotely over the internet, which makes it more efficient and convenient to use. The robotic arm can be used in a variety of applications such as manufacturing, agriculture, healthcare, and many more. With the use of sensors and actuators, the robotic arm can perform complex tasks with precision and accuracy. The use of machine learning algorithms can further enhance the capabilities of the robotic arm by enabling it to learn from its environment and adapt to new situations. The integration of IoT technology with the robotic arm has made it possible to collect and analyze data in real-time, which can help in making informed decisions.The development of the robotic arm has the potential to revolutionize the way we work and interact with machines.

ACKNOWLEDGMENT

I would like to express my sincere gratitude to all those who have contributed towards the successful completion of this project on IoT based Robotic Arm. First and foremost, I would like to express my heartfelt gratitude to my project guide Mrs. J.G. Sulakshaneand HOD Mrs. S.V. Karande, for providing me with valuable guidance, insightful suggestions, and constant encouragement throughout the project. I would also like to extend my thanks to Project Group members, who helped me in the designing and fabrication of the robotic arm. Their knowledge and expertise in the field of robotics have been invaluable in making this project a reality. Furthermore, I would like to acknowledge the support and assistance provided by my classmates and friends, who have always been there to lend their support whenever needed. Thank you all for your valuable support and contribution towards making this project a success.

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