REVIEW PAPER ON DESIGN & DEVELOPMENT OF
Gesture controlled robotic arm

Prof.O.C.Salvi, Shreyash Dalvi, Pratik Raorane, Mrunal Jadhav, Ninad Sawant

Department of Mechanical Engineering, Sindhudurg Shikshan Prasadik Mandal college of Engineering,

Kankavli, India

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Abstract –This review paper highlights the various aspects of a robotic arm after reviewing several successful research papers on manipulators. Nowadays, Robotic arms are being used in industries to minimize the human errors and increase efficiency, productivity, precision of the operations taking place. One of the most important advantages of introducing Robotic arm in Industries is that it can work in crucial conditions like high temperatures, pressures where it's risky for humans to work. Since a manipulator comes under Flexible Automation, they can be updated and modified easily.

*Key Words***: Robotic Arm, Controller, End Effector.**

1. INTRODUCTION

In today's world, robots and humans are working hand-in-hand for completion of their assigned task. An assistance robot is a robot which is self-governed and can work independently to perform the given tasks. Industries, military undertakings, medical sector are some of the fields where these robots are now being used. Working in assignments involving high temperatures or tasks like defusing bombs, handling molten metal might be fatal for people. Hence, Robots can replace humans to perform these kinds of dangerous tasks

1.1. Robotic Arm Definition:

A Robotic arm is basically a machine which is very similar to a human hand; it consists of a combination of links attached in series or parallel. It can be controlled by programming it to perform a specific task. Joints of the manipulator connect the links that leads to the Displacement which is dither translational or rotational. A kinematic chain is formed by the links of the arm. End Effector is the terminating part of this kinematic chain and it can be considered as the hand of a human.
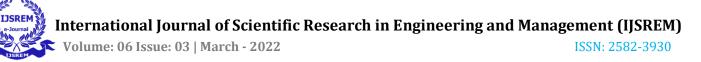

Fig 1: Proposed Robotic Arm

Types-
- Cartesian robot: - Three prismatic joints, whose axes are coincident with a Cartesian co-ordinate constitute a Cartesian robot. Arc welding, handling precision tools and pick and place work are some of its application.
- Cylindrical robot: - A robot is having axes that forms a cylindrical co-ordinate system is called as cylindrical robot. Some of its applications include assembly operations, handling at machine tools, spot welding, and handling at die-casting machines.
- Spherical robot: - A robot is having axes that forms a polar co-ordinate system is called a spherical robot. It is used for applications such as handling machine tools, spot welding, die-casting, fettling machines, gas welding and arc welding etc.
- Scara Robot: - Two rotary joints which are parallel and are used to provide compliance in a plane constitutes a
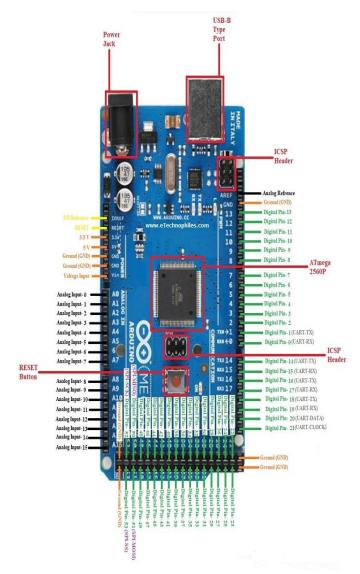
robot termed scara. Its applications include pick and place work, sealant, assembly operations and handling machine tools.

• Articulated robot: - A robot consisting of an arm having at least 3 rotary joints is termed as Articulated. It

Is used in die-casting, assembly operations, fettling machines, gas welding, arc welding and spray painting.

• Parallel Robot: - Arms having concurrent prismatic or rotary joints constitute a parallel robot. One of the use is a mobile platform handling cockpit flight simulators.

• Anthropomorphic robot: - A robotic arm which is similar to a human hand i.e. consists of independent fingers and thumbs is called as Anthropomorphic robot.

1.2 Controller

A device which takes multiple inputs to adjust its output so that the connected gadget operates in a controlled way is called as a controller. Microcontroller can be operated with more than one control outputs and carry out closed loop control. Choosing a specific controller is important for a final operation of a project

because different actuators require differing control methods to achieve stable output. Arduino and Raspberry Pi are the most widely used controllers now days.

2 Literature Review

2.1 A survey on Arduino Controlled Robotic Arm by "Ankur Bhargava".

In this paper Degree of Freedom (DOF) robotic arm have been developed. It is controlled by an Arduino Uno microcontroller which accepts input signals from a user by means of a set of potentiometers. The arm is made from four rotary joints and end effector also, where rotary motion is provided by a servomotor. Each link has been first designed using Solid works Sheet Metal Working Toolbox and then fabricated using a 2mm thick aluminium sheet. The servomotors and links thus produced assembled with fasteners produced the final shape of the arm. The Arduino has been programmed to provide rotation to each servo motor corresponding to the amount of rotation of the potentiometer shaft. A robot can be defined according to the nature of the relative movements between the links that constitute It. [1]

2.2 "Arduino Controlled Gesture Robot" by Deeban Ss, Harish Dhanasekarum Velayutha Rajan, Prasana Marimutha.

In this selective paper gestures of human hand can be replicated by implementation of the zigbee protocol to send the data wirelessly from human hand to robotic arm. The servo receives PWM (Pulse Width Modulation) signal from controller. PID control algorithm for more precise control with less overshooting. [2]

2.3 'Continuous sensing of gesture for control of audio-visual media' Wei Xin Sha, John Iachello, Steven Dow, Yoichiro Serita.

TAZAMA St. Julien, Julien Fistre Faculty of Literature, Communication, Computer and Culture / GVU Center Georgia Institute of Technology proposed the continuous detection of gestures to control the audiovisual media. They represent how the detection of the incessant movement can be achieved by using low power remote sensing to improve the expressive control of the age constant of sound and visual supports. [3]

2.4 'Hand gesture recognition' by Rafiqul Zaman Khan and Noor Adnn.

Ibraheem of the Department of Computer Science, A.M.U. Aligarh, India, in the International Journal of Intelligence and Artificial Applications (IJAIA) in July 2012 proposed hand signal recognition: a survey of writing. They said the hand motion recognition framework had an amazing consideration in the couple of years because of their complex applications and the ability to

interact with the machine effectively through human collaboration with the PC. They showed a review of the frames of recognition of last-minute movements. The key issues of the hand signal recognition framework are given the difficulties of the structure of the movement. [4]

2.5 A simple wearable hand gesture device using institute of medical and early modern studies Mr. Anala Pandit, Mr. Dhirya Dand.

In this paper people machine communicating device, most intuitive communicating device, to interact to the device and the other appliances. In case of communicating to the machine commands are being implemented use of hand gesture. Here accelerometer used to migrate the touchpad to revolve 3D object. Accelerometer changed to wireless communication 3D graphics can be done easily. Effective interaction. [5]

2.6 Modeling and Simulation of Robotic Arm Movement using Soft Computing by V. K. Banga, Jasjit Kaur, R. Kumar, Y. Singh.

In this research paper the authors successfully built 4 degrees of freedom robotic arm using soft computing. They have formulated ways for controlled movement of robotic arm and planning of trajectory with the help of Genetic Algorithms (GAs) and fuzzy logic (FL). As optimal movement is critical for efficient autonomous ROBOTS. This architecture is used to limit the issues related to the motion, friction and the settling time of different components in robotic arm. Genetic optimization is used to find the finest joint angles for this four d-o-f robotic system. This type of optimization replaces the long process of trial and error in search of better combination of joint angles, which are valid as per inverse kinematics for robotic arm movement. These logic models (Fuzzy logic) have been developed for the joint movement, friction and least settling time attributes as the fuzzy logic input. [6]

2.7 Design and Implementation of Wireless Robotic Arm Model using Flex and Gyro Sensor by Anughna N, Ranjitha V, Tanuja G.

The paper represents the author using accelerometers to collect information. The controller used is Arduino Atmega328. Human arm motion, fingers are located by flex, gyro sensors and signal are sent to Arduino ATmega328 which in turn controls the servo motors and makes the movement of the arm possible. The programming of the Arduino was done with the help of embedded C language. The Flex and Gyro Sensors were placed near the fingers. Whenever the change is detected, the information by both the sensors is processed by the controller. The Future Scope of this paper includes using 5 Flex Sensors near the fingers and more Gyro for the ease of operation. [7]

2.8 Industry Based Automatic Robotic Arm by Dr. Bindu A Thomas, nStafford Michahial, Shreeraksha.P, Vijayashri B Nagvi, Suresh M

This paper includes the design of an automatic robotic arm which is based according to the industrial applications. A functional prototype was constructed. This framework would make it simpler for man to maintain a strategic distance from the danger of dealing with objects which could be unsafe at the working environment. The utilization of robots is strongly suggested for Businesses particularly for security and profitability reasons. In their design work, they included a manipulator with 5 Dof. The microcontroller issues order to the individual channels that makes up the link. The electric motor operates as per given command and the speed of the motor as well as the direction and motion is controlled by the microcontroller. Meanwhile, in the mode of operation of robot, an obstacle sensor was programmed by the microcontroller such that it detects the presence of the obstacle in 10cm of radius. If an obstacle is sensed for the first time it pauses the work. Again if the problem is not cleared, a feedback system such as buzzer gets turned on to bring this problem on notice of a personnel to clear the object. [8]

2.9 'Robotic Arm Tracing Curve Recognized by Camera' by Timothy Karl Findling

This paper was a thesis on solving the problem of soldering a line on a remote surface using a laser beam with the help of a robotic arm consisting of 6 servo motors controlled by Arduino micro-controller. With the help of various algorithms, this robotic arm was used to solder the cracks on a surface. A camera was used as the feedback device to give the position feedback to the controlling software by giving the current position of the laser dot. The software used in this research consists mainly of Arduino micro-controller embedded software, an image processing software and a control software. The robotic laser arm was kept 81.28 cm away from a white board. Joysticks can also be used to position the robotic arm, in that the Arduino controller was disconnected from the PC.[9]

2.10 'Hand Gestures Remote Controlled Robotic Arm' by Shamsheer Verma

In this paper a manipulator with 3 d.o.f was made which was controlled by hand gestures. There is a glove which is a transmitter and the robotic arm is the receiver which functions according to the signals from the transmitter. The glove has a circuitry consisting of Arduino Mega 2560 which is programmed so as to transfer information through APC220 Module and receive data from the robotic arm. Three angles, alpha, beta and gamma are assigned to the hand, this, along with the acceleration in the three directions is taken care by the gyroscope and accelerometer by sending the signal to the Arduino Mega through wires, where all the information is combined and

processed. A flex sensor was also used to send the signals for the movement of the finger to the controller. The chassis of the robotic arm was made up of acrylic. [10]

2.11 'Path Planning and Co-simulation Control of 8 DOF Anthropomorphic Robotic Arm' by Sudharsan, Karunamoorthy.

This paper was published to focus on the efficiency of the path planning with the help of Matlab and ADAMS simulation software. The software's were used to execute the control algorithm in real time case and see the functional behavior of the system. This showed the results

of the real time working of the manipulator. To control the motions of joints a joint cubic path control algorithm are used with the help of MATLAB. The end effector of the robotic arm was kept similar to human palm and fingers. The arm was modelled in Pro-E software tool. Through simulations they got the results on torque, position, velocity and acceleration of the robotic arm. [11]

2.12 Smart Robotic Arm by Dishant Khosla, Manvinder Sharma, Sachin Krishan Khanna, Pratibha Khanna, Gurpreet Kaur

It is a study research based on a smart robotic arm which provides technical information and basics about it. The robotic arm is an issue which is being researched due to problems being faced in day to day life and due to this there are varieties of robotic arms present in market. This study includes the work of robotic arm and in which field it can be used. As we know robotic arm can be operated through various methods like app, remote control, voice command. In their project they have used GUI which comforts the user to use this app efficiently and conveniently. It gives choice to user that whether he/she has to cut fruits or vegetable; if fruits, then which type of fruits; if vegetable, then which type of vegetable and how it should be cut. Artificial intelligence and machine learning can also be used in robotic arm to provide extra smartness to the arm that will make it to think by its own and complete the task without human intervention.

Elements used in robotic arm are
- Arduino
- Servo motor
- Gear box
- Side shaft geared moto
- L298n motor. [12]

2.13 PLC based Robot Manipulator Control using Position based and Image based Algorithm by Harshavardhan Reddy Kunchala & Jack Toporovsky

The author of this paper has used Programmable Logic Controller for controlling the manipulator and also used two artificial intelligence algorithms that is position based

and image based algorithms. The manipulator used has 5 Degrees of Freedom. The position based algorithm calculates the joint velocity by the data provided by the algorithm based on images. The main purpose of this paper was to use the data from the images captured by the camera and the space coordinates to the specific object which at last controls the movement of the robot while performing certain task. The position determining algorithm outputs the X co-ordinates and Y co-ordinates in the image frame captured by integrated camera along with a scaling factor. The measurement related to gripper are done according to scaling factor and used to get an idea of the height of the gripper from the datum. This

makes process easier for machine to detect the position of object and come in same plane of the object. [13]

2.14 Development Of Robotic Arm Using Arduino UNO by 1Priyambada Mishra,2Riki Patel, 2Trushit Upadhyaya, 2Arpan Desai:-

In this paper, they have used 4 servo motors to make joints of the robotic arm and the movement will be controlled with the help of potentiometer. The controller used is Arduino UNO. The analogue input signals of the Arduino's are given to the Potentiometer. The arm has been built by the Cardboard and individual parts are attached to the respective servo motors. The arm is specifically created to pick and place light weight objects. So low torque servos, with a rotation of 0 to 180 degrees have been used. Programming is done using Arduino 1.6.10. Thus the paper basically focuses on creating a robotic arm with non-useful materials and its application on small purposes. [14]

3. CONCLUSIONS

Hence, we have successfully reviewed several research papers published by different authors for the better understanding of the development of the Robotic Arm.

So considering all the parameter of the robotic arm we have selected the human arm mechanism to our robotic arm, we overviewed counter weight mechanism, gripper mechanism and the algorithm like DH algorithm like genetic algorithm. We studied motor driver like ACT DM420, L293D motor driver and TB6600; here TB6600 were the most compatible driver among all we studied.

Robotic arms can be used to automate the process of placing goods or products onto pallets. By automating the process, palletizing becomes more accurate, cost-effective, and predictable. The use of robotic arms also frees human workers from performing tasks that present a risk of life injury.

4. ACKNOWLEDGEMENT

REFERENCES

[1] Ankur Bhargava, Anjani Kumar. 'Survey on Arduino controlled robotic arm' International conference on Electronics, communication & Aerospace Technology ICECA 2017.8212837, April 2017.

[2] Dheeban Ss Harish, Dhanasekaran Velayutha Rajan, Hari Vignesh, Prasana Marimutha. 'Arduino Controlled Gesture Robot' 2018 IEEE 4th international symposium in robotics & Manufacturing Automation (ROMA). ROMA4607.2018.8986730, December 2018.

[3] Shan Xin Wei, Giovanni Lachello, Steven Dow, Yoichiro Serita 'Continuous sensing of gesture for control of Audio visual media'. Wearable computers, 200re Review 3. Proceeding seventh IEEE International symposium on IEEE Xplore; ISWC.2003.1241417.

[4] Rafiqul Zaman Khan, Noor Ibraheem 'Hand Gesture Recognition' A Literature Review: August 2012 International Journal of Artificial Intelligence & Applications 3(4): 161-174. Ijaia.2012.3412.vol.3, No.4, July 2012.

[5] Anala Pandit, Dhairya Dand, Sisil Mehta, Shashank Sabesan, Ankit Daftery. 'A simple Wearable hand gesture device using institute of medical and early modern studies'. Proceedings of the 2009 International Conference of soft computing & pattern Recognition, December, 2009.

[6] [4] V. K. Banga, Jasjit Kaur, R. Kumar, Y. Singh "Modeling and Simulation of Robotic Arm Movement using Soft Computing", International Journal of Mechanical And Mechatronics Engineering, Vol:5, No:3,2011

[7]Anughna N, Ranjitha V, Tanuja G "Design and Implementation of Wireless Robotic Arm Model using Flex and Gyro Sensor", International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issue-5, January 2020.

[8] Dr. Bindu A Thomas, Stafford Michahial, Shreeraksha.P, Vijayashri B Nagvi, Suresh M "Industry Based Automatic Robotic Arm", International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 11, May 2013, ISSN: 2277-3754 ISO 9001:2008 Certified

[9] Timothy Karl Findling "Robotic Arm Tracing Curve Recognized by Camera", Florida Institute of Technology, Melbourne, Florida December, 2016.

[10] Shamsheer Verma "Hand Gestures Remote Controlled Robotic Arm", Advance in Electronic and Electric Engineering. ISSN 2231-1297, Volume 3, Number 5 (2013), pp. 601-606.

[11] Sudharsan, J.* & Karunamoorthy, L. "Path Planning and Co-simulation Control of 8 DOF Anthropomorphic Robotic Arm", Department of Mechanical Engineering, CEG Campus, Anna University, Chennai, India.

[12] Dishant Khosla, Manvinder Sharma, Sachin Krishan Khanna, Pratibha,Khanna, Gurpreet Kaur "Smart Robotic Arm", Journal of Artificial Intelligence Research & Advances,ISSN: 2395-6720 (Online),Volume 6, Issue2

[13]Harshavardhan Reddy Kunchala & JackToporovsky "PLC based Robot Manipulator Control using Position based and Image based Algorithm", Global Journal of Researches in Engineering: H Robotics & Nano-Tech Volume 17 Issue 1 Version 1.0 Year 2017 Type: Double Blind Peer Reviewed International Research Journal Publisher: Global Journals Inc. (USA) Online ISSN:2249-4596 Print ISSN:0975-5861.

[14] Priyambada Mishra, Riki Patel, Trushit Upadhyaya, Arpan Desai "Review of Development Of Robotic Arm Using Arduino UNO", International Journal on Recent Researches in Science, Engineering and Technology, ISSN: 2348-3105 Volume 5, Issue 5, May 2017.