International Journal of Advanced Technology in Engineering and Science
Vol. No.5, Issue No. 04, April 2017
www.ijates.com
ijates
ISSN 2348 - 7550

MODEL OF ROBOTIC ARM ALONG WITH SCREW HOLDING FIXTURE FOR OXIDIZING PROCESS

Prashant Kshirsagar[1], Shubham Karade[2],Rohan Nadkarani[3]
Amol Marachande[4],Prashant Mane[5]

[1]Assistant Professor, [2,3,4,5] Final Year Students Departmentof Mechanical Engg, RMCET Ambav, Mumbai University(India)

ABSTRACT

The popular concept of a robot is of a machine that looks and works like a human being. The industry is moving from current state of automation to Robotization, to increase productivity and to deliver uniform quality. One type of robot commonly used in industry is a robotic manipulator or simply a robotic arm known as pick and place robot. It is an open or closed kinematic chain of rigid links interconnected by movable joints. In this work in first stage our focus on theoretical development of robotic arm model along with screw holding fixture for oxidizing processforindustrial applications. The first is the holding device for oxidizing process of screw and the second is a robotic assembly using passive compliant devices. For each problem an end-effector device was designed, built and tested using a robotic manipulator with four degrees of freedom. Another reason behind the automation is that the products which are manufactured by the company (Adler Mediequip Pvt. Ltd.) are internal body parts which are placed inside the human body. Hence it is required that there should be proper preciseness of product.

Keywords :Control ,Fixture, Fabrication, Robot, ,Oxidization

I. INTRODUCTION

It is a company need to have an automation in their current process of anodizing.[1][2][3] Fulfilling their need we are fabricating a holding fixture along with robotic arm. A screw is to be anodized forming an oxide layer on its head portion. These screws are going to be used in the human body in case of fracture, so preciseness of the finished product is must. For getting this precise nature a fixture is designed, due to which only the head portion is oxidized without affecting the threaded area. Considering the automation, the robotic arm is designed for holding the fixture, providing the smooth deep into the anodizing solution. A microcontroller is used to control all the motions of robotic arm. All these provisions results in getting the uniform layer on screw head.

II. PROBLEM DEFINITION

Current process for oxidising requires lots of human efforts and time, while the finished product obtained has room for improvement since the quality of finished product is not satisfactory.Solution for this problem is given

by providing a screw holding device along with robotic arm. This will overcome above mentioned problem and will improve the quality of finished product.

III. METHODOLOGY

3.1 Extensive Literature Survey

3.2 Design of Screw holding Fixture and Robotic Arm

3.3 Selection and procurement of material, Microcontroller.

3.4 Fabrication of the model

3.5 Testing and implementation of model at work station.

IV. DESIGN CONSIDERATIONS AND MATERIAL SELECTION,CALCULATIONS

4.1 The following were put into consideration in the design process:[4][5]

4.1.1 Electrical actuators DC servo are chosen instead of hydraulic or pneumatic actuators

4.1.2 Reduction in the weight concentrationContinuous path controller –microcontroller (Ardiuno)

4.1.3 Fixture should be tight fitting, it should not damage screws and it should be properly sealed

4.1.4 Material Selection:

For making any device, materials used plays a very important role because the strength and the rigidity of the structure depends on the type of material used. There are many properties of material which affect the working of the material like strength, rigidity, vibration, damping etc.

Following are materials which are used for this work.

i. Aluminium
ii. Copper
iii. Polypropylene (PP)

For the model of fixture we are using PP as it is light weight and will sustain in the acidic solution. Copper is used for the upper plate so as to pass the current in the screws.For robotic arm we selected aluminiumfor its light weight and its properties like high strength, low density,etc.

4.2. Oxidation process:[6][7]

It is an electrolytic passivation process used to increase the thickness of the natural oxide layer on the surface of metal parts. Anodic oxidation is a commonly used surface treatment. Its aim is to improve the corrosion or wear resistance, the external aspect, and the ability for adhesive bonding. The application of anodic oxidation to the surface preparation of titanium alloys is more recent. It was found that at 10 to 30 volts and 5 to 6 seconds, the Titanium alloy was effectively oxidized and, the coating formed was very smooth and clear.

4.3. Solution prepared for the oxidizing process

Sulphuric acid + water: (2.5 ltr + 30 ltr)

Trisodium + water: (400 gms + 30 ltr)

4.4. Formula for layer thickness[8][9]

Thickness = (P2 − P1)/(S × D) (1)

Where,

P2 -weight after oxidization P1 - weight before oxidization

S - Surface area of the Titanium alloy D - Density of the Titanium alloy

Table 1: Color based on voltage supplied

Color on layer	Voltage(volts)	Time(Sec)
Gold	10	5
Blue	20	5
Purple	19	5
Sky Blue	25	5

4.5 Torque and Speed Calculation

The main criteria to be considered for the selection of motor are torque and speed.

Torque is the tendency of force to rotate an object about an axis.

Mathematically, torque is defined as the cross product of the lever-arm distance and force, which tends to produce rotation. i.e. T= F * L Nm ,Where,F= force acting on the motor , L= length of the shaft Force.

F is given by, F= m * g N ,Where, m=mass to be lifted by the motor , g= gravitational constant = 9.8 m/s

Calculation of the torque starts from the gripper and moves downward till the base joint of the arm. Hence base Joint carries the maximum payload i.e it should carry the weight of the upper 3 motors also. The robotic arm is of three joints. One motor each at the 3 joints. The torque and speed calculation differs at each joint depending on the payload.

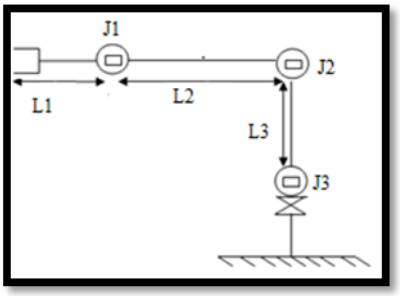

Fig. 1 Robotic arm designs

Torque for the first joint is calculated as from above figure as,

T1 = F1 * L1

F1 = m1 * g

Consider,

Weight to be lifted = 2 kg

Weight of the gripper = 5.5kg

Total weight on joint1 = m1= 4.2kg

Length of the gripper = L1= 0.2m

F1 = 4.2*9.8

F1 = 41.20 N

T1 = F1*L1 = 41.20*0.2

T1 = 8.24 Nm

By considering service factor, S.F=1.25

$T1_{max}$ = 8.24*1.25=10.30Nm

Similarly, the torque for the other joints is also calculated but for the succeeding joints, the weight of the above motor and the length get added.

Torque for 2nd joint = T2 = F2 (L1+L2)

Torque for 3rd joint = T3 = F3 (L1+L2+L3)

Torque for base motor =Tb = Fb (Lb + L1+L2+L3)

The calculation of the torque can be tabulated as below:

Table 2: Torque calculation

Location of motors	Link length (m)	Total mass (kg)	Force (N)	Torque (min)	Torque (max)
Joint 1	0.2	4.2	41.20	6.18	7.72
Joint 2	0.55	4.5	44.55	24.50	30.62
Joint 3	1.05	5	49.05	51.50	64.37
Base	1.15	8	78.40	90.16	112.7

V.CONSTRUCTION

5.1 Construction of fixture

The fixture contains following parts:

1. Main body
2. Middle plate

3. Rubber plate
4. Upper copper plate
5. Grommets

The grommets is the main element of the fixture, it is fixed in the main body. The middle plate is placed between the cavity of main body and the copper plate. It contains threads same that of the screw so as to lock the screw. The copper plate is at the top of main body just after the rubber plate. Copper plate is tightened with body with the help of bolts.

5.2 Construction of robot assembly

The robot assembly contains following parts:

1. Aluminum links
2. Gripper assembly
3. Base plate
4. Servo motors with couplings
5. Thrust bearing
6. Electronic set up (Controller, diodes, LED display, etc.)

Three links of aluminum bar are connected together with the help of servo motors and couplings. These links are mounted on base plate. A thrust bearing is placed below to rotate the whole assembly about 180^0. The electronic set up is attached which includes controller, LED display, etc. to control the motion of the links and base plate.

VI.WORKING

6.1 Working of fixture

The fixture is so designed that it would be operated by the semiskilled worker too. When the screw is inserted into the fixture from grommets, it will get tighten by the middle plate. The screw gets lock up to desired limit in the grommets and will touch to the copper plate. The grommets are provided for the proper sealing action. The current is provided by the gripper and it passes through copper plate to the screw. The screw will then act as anode and solution of sulphuric acid acts as cathode. When current is supplied, the chemical reaction takes place and the head portion of screw which is in the contact with acidic solution, will get oxidized. The screws are then unloaded from fixture and carried for the further operation of cleaning.

5.2 Working of Robot Assembly:

The robot assembly is controlled by the controller (Ardiuno). When the power is supplied to the robot arm, it picks the fixture from the loading table and deep it into oxidizing tank. The chemical reaction is then takes place between screw and the sulphuric acid. After 5 to 7 seconds a layer is formed on the head portion. The arm then raise the fixture from the tank and place it at the unloading table. And the cycle continue till desired production

VII. ACTUAL SETUP

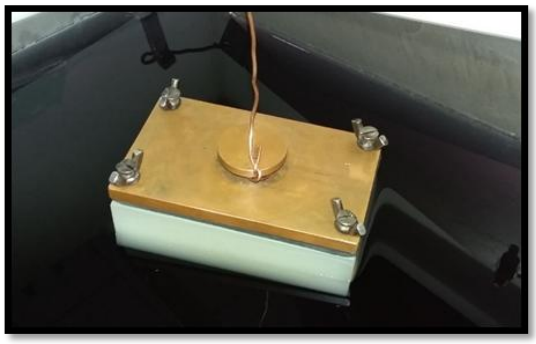


Fig. 3 Project setup

VIII.EXPECTED RESULTS DISCUSSION

1. It is to be found that, fixture is fulfilling the company requirement by providing the preciseness of finished product.
2. The desired oxidized layer is obtained up to the precise level.
3. During a trial on robotic arm, unfortunately the servo motors breaks down and the whole assembly got collapse. The selection of motors was wrong and hence the robot could not work properly.
4. Hence it is advisable to utilized advanced servo motors with required specifications as per the load.

Fig. 4 Oxidized screw

IX. CONCLUSION

Fabrication work of screw holding fixture and designing and fabrication of pick and place robot arm has been successfully done. However, it was found that the robot arm is not able to carry the desired load due to insufficient torque capacity of servo motors that have been used in this project. Hence it is advisable to utilized advanced servo motors with required specifications as per the load. Though it was not affordable to use such advanced motors in this project because of standardization issue, the manual oxidation of the screws with

accurate and precise coating has been achieved by the use of screw holding fixture and overcome the necessity of tapping operation for the screw before doing oxidation process.

X.ACKNOWLEDGEMENT

Authors of this paper are thankful to Mr.Prakash Kale, HR Generalist, Mr.AshishPrabhu Desai, Management Representative,Mr.PradipThik, Works Manager, from Adler Mediequip Pvt. Ltd., for providing us opportunity to implement knowledge practically. Head of department, Prof.S.R.Bhandari,Principal Dr.M.M.Bhagwat for their constant support and motivation. We thank deeply to invaluable guidance rendered to us all occasion by all others to directly or indirectly contribute to our humble performance.

REFERENCES

[1] N. Firthous Begum1, P. Vignesh2,*Design and Implementation of Pick and Place Robot with Wireless Charging Application, International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064* Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438.

[2] N. B. Ekwe, D. F. Aloko,*Anodization of Aluminum, International Journal of Scientific and Research Publications, Volume 3, Issue 3,* March 2013 1 ISSN 2250-3153

[3] RavikumarMourya, AmitShelke, SourabhSatpute, SushantKakade, ManojBotre ,*Design and Implementation of Pick and Place Robotic Arm,International Journal of Recent Research in Civil and Mechanical Engineering (IJRRCME) Vol. 2, Issue 1, pp: (232-240),* ISSN 2393-8471

[4] Sami AbualnounAjeel, RustamPuteh, YaqoobMuhsin Baker,*Experimental Study OfAnodizing Process For Stainless Steel Type 304" Wulfenia Journal ISSN: 1561-882X Vol 20, No. 3;*Mar 2013

[5] Li,a,* ZhiweiShi,b and ChangxiongZhua,* *"Trends in Research on Electrochemical Oxidation" CroaticaChemicaActaCcacaa, ISSN 0011-1643, e-ISSN 1334-417X Croat. Chem. Acta 87 (2) 185–194* Hongna, (2014)

[6] *A. Zykova1, V. Safonov1, J. Smolik2, R. Rogowska2, V. Lukyanchenko3, A. Samoilenko4 "Examination of surface and material properties of nanostructural oxide coatings for joint total and module replacement arthroplasty" Ортопедия, травматология и протезирование.* PP: 51–57, ISSN 0030-5987, 2013.

[7] AnushaRonanki 1, M. Kranthi 2, *Design and Fabrication of Pick and Place Robot to Be Used in Library,International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 6,* , ISSN(Online): 2319-8753, ISSN (Print): 2347-6710,June 2015

[8] N. B. Ekwe, D. F. Aloko ,*Anodization of Aluminum,International Journal of Scientific and Research Publications, Volume 3, Issue 3,* March 2013, ISSN 2250-3153,Chemical Engineering Department, University of Abuja, Nigeria.

[9] 1B.O.Omijeh, 2R.Uhunmwangho, 3M.Ehikhamenle ,*Design Analysis of a Remote Controlled Pick and Place Robotic Vehicle ,International Journal of Engineering Research and Development e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com Volume 10, Issue 5* ,PP.57-68, (May 2014).

[10] Mikell P. Groover, Mitchell Weis, Roger Nagel, Nicholas Odrey ,*Industrial Robotics Technology Programing and Applications* International Edition 1986 .

[11] Mikell P. Groover, *Automation, Production System and Computer Integrated Manufacturing* ,3rd edition, copyright © 2008.

[12] Dr. P. C. Sharma ,*Production Engineering, text book* , first edition 1998.