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Model of Robotic Arm Along with Screw Holding Fixture for Oxidizing Process

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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 robot applications. The first is a robotic assembly using passive compliant devices and the second is the holding device for oxidizing process of screw. For each problem an end-effector device was designed, built and tested using a robotic manipulator with four degrees of freedom. The devices are presented together with the experimental results.*
Keywords: *Fixture, Robot, Control, Oxidization, Fabrication*

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 anodising 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

- **i.** Extensive Literature Survey
- **ii.** Design of Screw holding Fixture and Robotic Arm
- **iii.** Selection and procurement of material, sensors, Microcontroller.
- **iv.** FEA analysis of the CAD model
- **v.** Fabrication of the model
- **vi.** 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]

- **i.** Electrical actuators DC servo are chosen instead of hydraulic and pneumatic actuators
- **ii.** Reduction in the weight concentration
- **iii.** Continuous path controller – microcontroller
- **iv.** Fixture should be tight fitting, it should not damage screws and it should be properly sealed

4.2 Material Selection:

For making any machine, 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 may considered for this design.

- **i.** Mild (low carbon) steel
- **ii.** Aluminium
- **iii.** Grey cast iron
- **iv.** Polypropylene (PP)

For our model we selected aluminium as it is light in weight and its properties like high strength, low density, current carrying capacityetc.

4.3. Types of Sensors used:

Proximity sensor
Location sensor
Voltage sensor
Acceleration sensor

4.4. 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.

4.5.Solution prepared for the oxidizing process

Sulphuric acid + water (2.5 ltr + 30 ltr)
Trisodium + water (400 gms + 30 ltr)

4.6. 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

Moment = force x perpendicular distance (2)
Assuming that the weight of the material is negligible since it light compare to the servo specification.
W_0 =56g, W_1=56g, W_2=56g, W_3=36g
Moment sustained at the shoulder M1 (0.036 x 47) + (0.056 x 40) + (0.056 x 18) = 4.94 [kg-cm]
But actual torque of the shoulder servo = 13 [kg-cm]
Excess torque = Actual servo torque – Calculated torque (3)
Therefore, excess available torque at the shoulder = 13 – 4.94 = 8.06 [kg-cm]
Moment sustained at the elbow M_2 = (0.056 x 22) + (0.036 x 29) = 2.276 [kg-cm]
But actual torque of the Arm servo = 13 [kg-cm]
Excess available torque at the shoulder = 13 - 2.276 [kg-cm]
Moment sustained at wrist = (0.056 x 7) = 0.392 [kg-cm]
But actual torque at the wrist servo = 13 [kg-cm]
Excess torque =13 – 0.392 = 12.608 [kg-cm]
Moment sustained at the base = (23-5 x 0.204) = 4.97 [kg-cm]
Excess torque = 13 – 4.97 = 8.206 [kg-cm] [10]

V. Proposed Setup

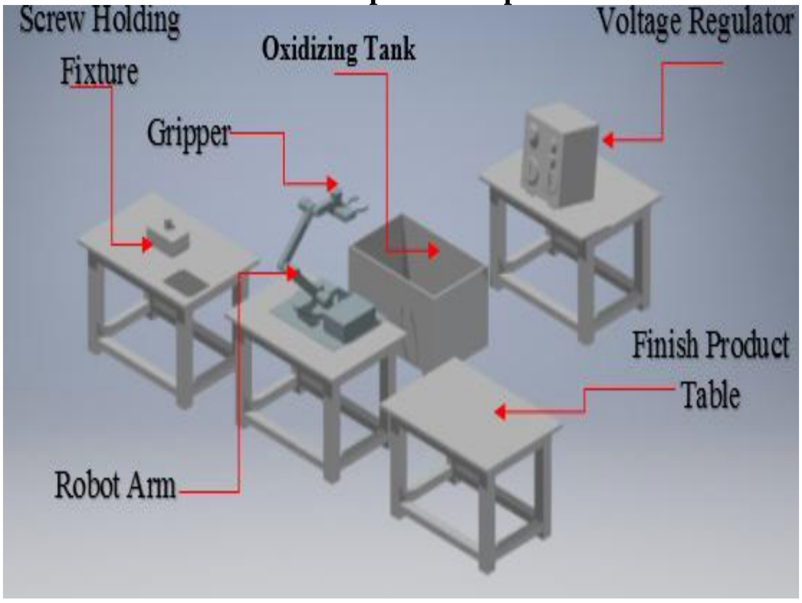

Fig. 1: Project setup

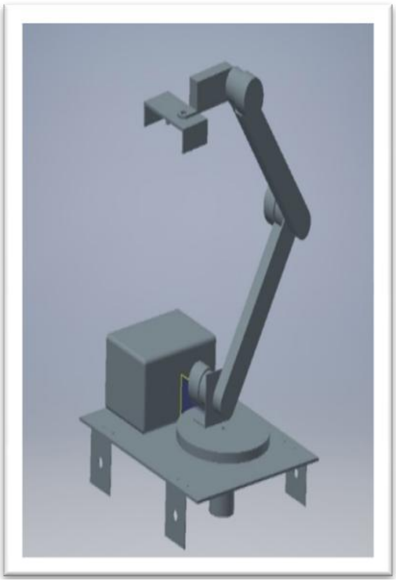

Fig. 2: CAD model of robot

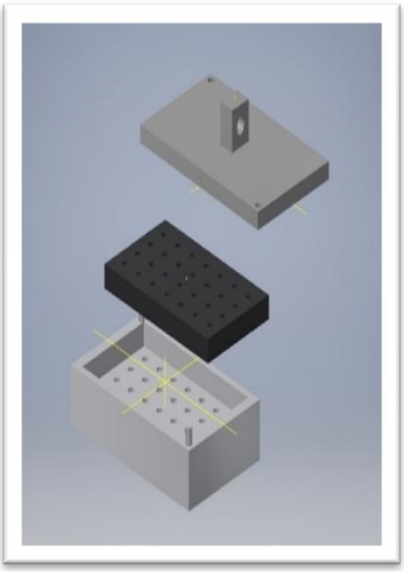

Fig. 3: Holding Fixture

VI. Expected Results Discussion

1. After finalizing the design and proper fabrication of model, it is to be tested on the work station whether it is working properly or not. If it is, then the reduction in time consumed for total process is possible.[10]
2. As it is a semiautomatic handling system, the quality of finished product is better than the previous one. As well as the production rate is considered to be increase.[11]
3. The man power is going to reduce due to the robotic arm and screw holding device.[12]
4. With the increasing production rate, the productivity will increase and it will result in increase of profit as well

VII. Conclusion

At the end of project it is to be found that, the automation used instead of conventional method was much effective. The quality of the finished product is better than the previous one. Due to automation the time for overall process is reduced. Also the man power is reduced due to use of robotic arm and the screw holding fixture. The production rate is increased, affecting the increase in the profit of company.

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