DESIGN OF LOW-COST PNEUMATIC PICK AND PLACE ROBOT

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Abstract: The paper proposes a shabby and successful strategy for structure and assembling of a three level of opportunity revolute jointed mechanical arm. The planning procedure starts by determining top-level structure criteria and going down these criteria from the best level of the controller's structure to every single ensuing part. With this proposed methodology the successive structure plans are caught, sorted out and actualized dependent on the whole framework goals, rather than the regular plan process which goes for individual parts improvement. By considering the mechanical arm's execution destinations, the structure begins with demonstrating the incorporation of all the individual connections comprising the controller. Amid the planned procedure, adjustments are made dependent on coordinated data of kinematics, elements and basic examination of the coveted robot arrangement all in all. An ideal get together the plan is then accomplished with functional substructures of the controller segments. Thus, the proposed methodology for controller configuration yields generously less number of cycles, the programmed proliferation of configuration changes and extraordinary sparing of plan endeavors. Advance with best machining procedure and least expensive material, providing food with the quality and machining necessities reasonable materials are chosen to satisfy the goal.

Keywords **- Cost, design, manufacturing, pneumatic, robot.**

I. INTRODUCTION

Mechanical autonomy is the art of planning and building robots reasonable for genuine applications in robotized fabricating and other non-producing environments.‖ according to International Standards Organization (ISO), it can likewise be characterized as, ―An modern robot is a programmed, servo-controlled, uninhibitedly programmable, multipurpose controller, with a few territories for the treatment of work pieces, devices or extraordinary gadgets. Dynamically customized activities make the execution of an assortment of errands possible.‖ Here we are structuring a mechanical arm that is totally utilitarian by pneumatic standards and in this way diminishing the multifaceted nature in planning, fabricating and machining. This aides in decreasing the general expense of the robot ideal from structuring to assembling since costly electronic circuits are not utilized. At the point when contrasted with electronic robot these pneumatic robots with synchronous and successive pneumatic circuits are equipped for playing out a similar undertaking consequently with help of even an incompetent work which thusly decreases the running expense of the machine. These kinds of pneumatic robots can be utilized in spots where dreary activity is required, for example, the sequential construction system and furthermore in spots where remote task is required. The achievement and progression of these kinds of robot depends predominantly upon the multifaceted nature of the pneumatic circuit. Viable structure builds the productivity and utilization of these robots.

II. DESIGN CONSIDERATION

1. **System Specification**
   Reach
   Range
   Work envelopes
   Load capacity
2. **System configuration**
   Number of degrees of freedom
   Joint Configuration
   Joint travel range
   Drive configuration
3. **System Performance**
   System Velocity and Acceleration
   Repeatability
   Resolution
   Accuracy
   Component life and duty cycle
4. **Detailed design of various components**
   Robot structures
   Robot Joints
   Actuators
   Transmission
   Wiring and routing of cables and hoses

1. DESIGN OF RELIABLE MECHANICAL JOINTS

The capacity of a joint is to allow relative movement between two connections or arms of a robot. It gives controlled relative movement between two connections (information and yield). For the most part, one joint gives the robot one level of opportunity. There are different joints, for example, the straight joints, symmetrical joints, rotational joint, curving joints and spinning joints. Of the given joints the rotational joints are anything but difficult to produce and is the best reason for our interest. Subsequently, pivoted joints are utilized. The expense of pivoted joints is less and can best fulfil our necessity. Anyway dependent on the quality and weight to be lifted different sorts and nature of pivoted joints are utilize.

2. MANIPULATOR DESIGN

A controller is by and large mounted on a track or suspended from a track that is equipped for achieving different separations and areas. It is utilized to move materials, apparatuses and objects without direct human contact. It comprises two segments to be specific the body or arm and the wrist gets together.

2.1 Design of body

The body is used to position the object in the robot's work envelope. What's more, in this manner by utilizing the idea of significant worth building a legitimate plan can help decrease the heaviness of the body and furthermore the measure of materials utilized. Generally to optimize both material cost and the manufacturing cost the arm is made up of different components and then is assembled together, thus saving the material and reducing the cost.

2.2 Design of wrist assembly

It is used for the orientation of the object in the work envelope. The end effector is connected to the wrist get together. Wrist gets together has three degrees of opportunity pitch, roll and yaw. However for simple pick and place application keeping in mind the complexity of manufacturing of the wrist assembly the end effector can be attached to the arm directly using hinged joints. A pneumatic chamber is utilized for controlling the end effector. Thus contributes significantly to reducing the cost of the robot.

3. DESIGN OF END EFFECTOR

The arm is responsible only for positioning the object. It the end effector that collaborates with the protest. The different end effectors are grippers, sprayers, processors, welders and vacuum. Here we utilize either a gripper or a vacuum. A gripper utilized for lifting and setting objects is easy to plan and fabricate. A vacuum can utilize the pneumatic power and, in this way, lessen the running expense and furthermore perform complex errands.

4. ROTATION OF THE ROBOT

For the robot to achieve distinctive areas and play out the errands it needs to pivot around its very own hub. Along these lines depending upon the prerequisite either a stepper engine or a straightforward pneumatic barrel can be utilized. A stepper engine needs electronic circuits for control and an extra bearing help for 360-degree revolution. Be that as it may, if a 90-degree range of turn is adequate then a pneumatic barrel can be utilized. Here just a single bearing to help the pivot is required. Along these lines altogether lessening the expense of the robot.

5. PNEUMATIC CIRCUIT

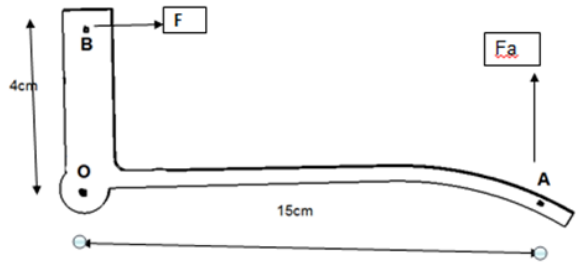
A pneumatic rationale framework is, for the most part, used to control the mechanical robots. Since electronic circuits and not utilized hence exact and precise pneumatic circuits are structured and executed. Consecutive circuits are planned with the goal that every barrel is activated at an appropriate arrangement and are likewise kept dynamic for the coveted timeframe. This the main test in a minimal effort mechanical arm is planning of the pneumatic circuit.

6. MATERIAL SELECTION

Material choice is a standout amongst the most essential factors in diminishing the expense of the robot. Materials are chosen so that there is no trade-off in the least structure necessity. Here too we utilize a blend of iron and fibre strengthened plastic. Gripper and the abdominal area can be made of FRP in light of the fact that it gives adequate solidarity to hold and lift the question and decrease the weight. The lower body and the base is made of iron with the end goal to give the required stabilizer so the soundness of the robot is not lost. Contingent on the weight to be lifted the material choice differs. Any way to lessen the expense and simplicity of assembling we can utilize press if weight contemplations are absent.

III. CALCULATIONS

A. CALCULATION FOR END EFFECTOR



Force (Fa) required for holding the work piece is 30 N
Fa = 30 N

Take moment at point O,
Let force at point B be F and is equal to the force applied by the cylinder. Fa is the force required to hold the object

Fa*15=F*4

F = 30*(15/4)

F = 112.5 N
Thus 112.5N of force should be supplied by the pneumatic.

B. SELECTION OF END EFFECTOR CYCLINDER

Pressure (P) supplied by the cylinder = 4 bar

Let area of cylinder be A.

A=F/P

= 112.5/(4*10^5)

=2.812*10^(-4) m2

A=3.14*d^2

d=18.9 mm

C. SELECTION OF BODY CYCLINDER

Pressure supplied to cylinder = 10 bar.

Assuming factor of safety as 2 the pressure supplied is assumed as 4 bar.

To lift an arm of 15kg,

Pressure= 4*105 N/m2

Area = force/pressure

A= 15*9.81/(4*10^4)

A= 3.678*10^(-4)

A=3.14*d^2

Therefore d= 21.6mm

Since the available standard cylinder is of diameter 25mm and stroke length 100 mm, the cylinder used for the arm lift are selected with the dimensions of 25mm x 100mm.

IV. COST ESTIMATION

S.NO	PART	MATERIAL	QUANTITY	COST (INDIAN RUPEES)
1	Cylinder (25*100)	Aluminium	3	2100
2	Cylinder (25*75)	Aluminium	1	500
3	Upper Body	Iron (Iron plates)	0.7kg	31.5
4	Lower Body	Iron (Iron plates)	0.7kg	31.5
5	Base Plate	Iron (Iron plates)	3kg	135
6	Gripper	Iron (Iron plates)	0.5kg	22.5
7	Bearing	Stainless steel	1	1650
8	Solenoid Valve	Plastic	4	1780
9	Tubes	Plastic	15 meters	150
10	Average labour cost	-	-	590
11	Average machining Cost	-	-	230
	TOTAL			**7220**

V. CONCLUSION

The compelling plan and assembling of 3 level of opportunity pick and place robot have been performed. The task of different arm linkages and the end effector has been widely tried and the required restorative measures were taken. Thus the goal of structuring and assembling of a pick and place robot requiring little to no effort was fruitful and can be actualized to supplant the costly electronic robots. It's been demonstrated that the running expense of the robot is likewise less. This will chop down work and enhance benefits at a low introductory venture.

VI. ACKNOWLEDGMENT

This work was upheld by the staff support and offices given by the division of mechanical designing, St. Joseph's school designing, Chennai, India.

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