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Design and Fabrication of Low-Cost Pick and Place Equipment

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Abstract – *In the today's industrial world the need of the automation increased drastically to decrease the errors and increase the efficiency. The paper describes about the low-cost semi-automated pick and place equipment with the design and manufacturing details. The equipment takes a product from one spot in the manufacturing process and place it in another location. The main purpose of the equipment is to reduce the human errors and increase the productivity and efficiency. The pick and place equipment uses stepper motor, ball screw and pneumatic cylinder.*

Key Words: **Design, Manufacturing. Low cost, Productivity, Automation**

1. INTRODUCTION

Pick and place is used in various industrial purposes such as material transfer applications. The equipment takes the product from one spot in manufacturing process and places it in another location and it is designed by calculating the speed, capacity, maximum and minimum product sizes, precision, accuracy and type of end effector. The end effector plays a major role based on the product the end effector is selected. In this paper way connector is used as a end effector which is pneumatic external thread gripper.

1.1 OBJECTIVE

The objective of the project is to make work space more ergonomic to the operator that is by reducing the operator work and make the workplace more comfortable. The workspace can be in manufacturing or assembly process. By using this equipment, the process can be easily controlled with more accuracy and repeatability than the operators.

Another objective is to create a simple and low-cost pick and place equipment as per the requirements.

2. LITERATURE REVIEW

Ravikumar Mourya, Amit Shelke, Saurabh Satpuite, Sushant Kakade, Monoj Botre have main objective of their project are to design and implement a four DOF pick and place robotic arm. They conclude that the CAD tools like Creo1.0 and Auto CAD are used to model the desire manipulator. To determine the end effectors position and orientation, theoretical analysis of inverse kinematics is carried out. Ansys software is used for FEA analysis.

Prof. S.N.Teli, Akshay Bhalerao, Sagar Ingole, Mahesh Jagadale. This project aims to design and fabricate the pneumatic arm for pick and place of cylindrical objects. They conclude that arm is controlled by manually flaw control and direction control valve. Arm rotation and movement is done by pneumatic cylinder using helical slot mechanism. Total arm weight is 25 kg. The model is expected to lift at least 10 kg weight

S.Premkumar, K.Surya Varman, R.Ballamurgan, Experimental aim is to collaborate the gripper mechanism and vacuum sucker mechanism working in single pick and place robotic arm. These robots can perform tasks like gripping, sucking, lifting, placing, releasing, in a single robotic arm. It will reduce the cycle time, Ideal time, cost of operation, space consumption. It is user friendly and effectively used in glass handling system.

M.Pellicciari, G.Berselli, F.Leali, A. Verganana. This paper shows the method for reducing the total energy consumption of pick and placed robotic arm. Firstly, electro mechanical models of both series and parallel manipulators are derived and then by means of constant time scaling, the energy optimal trajectories are calculated. It is seen that blowing down an operation as much as possible is not always beneficial. Energy consumption of given operation as a function of the task execution time. Future work includes improvement of the motor model, development of online programming algorithms.

Based on the comparison of various solutions existing and problem-solving techniques from the above researchers I have designed and fabricated a pick and place equipment.

3. DESIGN OF THE PICK AND PLACE EQUIPMENT

After the several conceptual designs of the pick and place arrangement, this design was finally approved and I started developing the design related to the manufacturing with reduced cost.

3.1 DESIGN CONSIDERATIONS

Following were put into consideration in the design process,

1. Electrical actuator DC stepper motor and pneumatic cylinder are chosen of little power requirement and its light weight which is suitable for the design.

2. Material used for the fabrication was locally sourced from the available materials. (mild steel)

3. The material which will be used for the design should be light in weight also cost should be less.

3.2 DESIGN SPECIFICATIONS

For our application 2 degree of freedom is suitable .X axis movement is actuated by the ball screw driven by the stepper motor and Y axis movement is actuated by the pneumatic cylinder and an external thread gripper for picking the product.

The most suitable material for our need is mild steel due to easy availability in the market with low cost and also very strong due to low carbon content.

Specification	Value
Number of axis	2
Horizontal reach	650mm
Vertical reach	100mm
Drives	1 stepper motor(X axis) 1 pneumatic cylinder(Y axis)
Configuration	2 axis plus gripper 2 axis are completely independent 2 axis can be controlled simultaneously

Table no.1 specification and value of the pick and place equipment

Considering the all points in the designing, CAD software (creo software) is used for the pick and place design.

3.3 DESIGN DATA FOR THE PICK AND PLACE

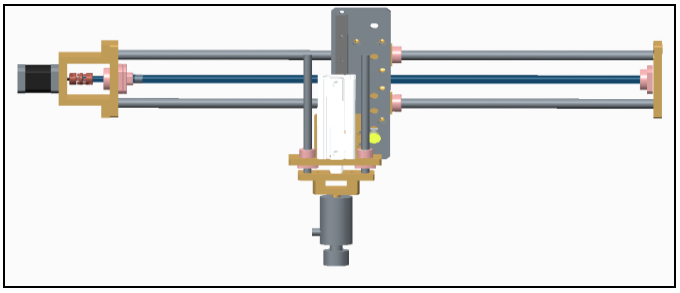

Fig -1: Pick and place (front view)

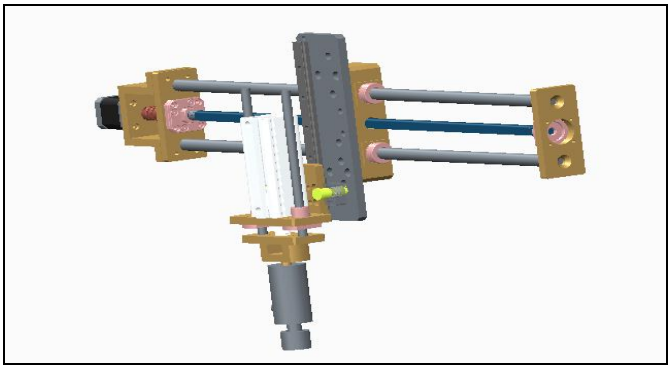

Fig -2: Pick and place (isometric view)

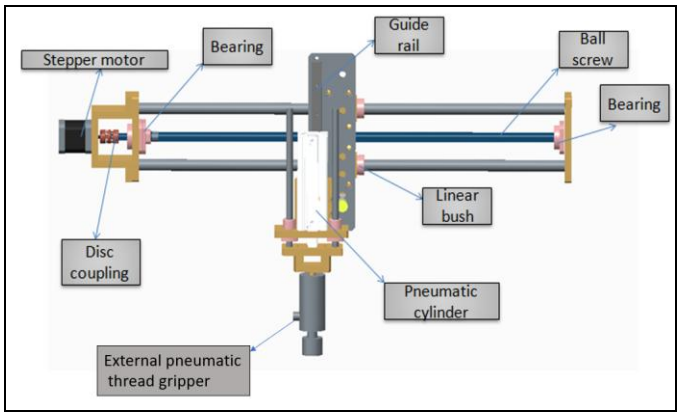

Fig -3: Standard components

SNO	PART DESCRIPTION	MATERIAL	QTY	SIZE
1	SLIDER	MS	1	155X48X40
2	BALL SCREW SUPPORT PLATE A	MS	1	120X50X10
3	BALL SCREW SUPPORT PLATE B	MS	1	120X50X10
4	CYLINDER BRACKET	MS-WELD	1	REFER DETAIL
5	MOTOR MOUNTING BRACKET	MS-WELD	1	REFER DETAIL
6	GUIDE ROD MOUNTING PLATE	MS	1	90X40X10
7	SETTING CHANGE OVER PIN ADAPTOR	MS	1	30X30X13
8	CYLINDER ASSEMBLY MOUNTING PLAT	MS	1	70X250X10
9	SETTING CHANGEOVER PIN ASSEMBLY	EN8	1	REFER DETAIL
10	BALL BEARING	STD	2	TYPE:HBR10X MAKE:SKF
11	FLANGE TYPE LINEAR BUSH	STD	2	TYPE:LHFC10 MAKE:SKF
12	DOUBLE TYPE LINEAR BUSH	STD	2	TYPE:SLMU W16 MAKE:SKF
13	MOTOR COUPLING	STD	1	TYPE:CPDW19_8_8 B
14	HYBRID SERVO	STD		TYPE:33KG-CM,7AMP DRIVE
15	BALL SCREW	STD	1	TYPE:_ MAKE:
16	CYLINDER	STD	1	TYPE:CDQ2A32-100DZ- M9PLS_SWITCH_A9_M MAKE:SMC
17	EXTERNAL WAY CONNECTOR	STD	1	
18	LINEAR GUIDES	STD	1	TYPE:SSEBLZ16_260_R MAKE:SKF
19	SPRING		1	
20	CAP SCREW	STD		M8X6
21	CAP SCREW	STD		M6X14
22	CAP SCREW	STD		M5X8
23	CAP SCREW	STD		M4X8
24	CAP SCREW	STD		M3X9
25	DOWEL PIN	STD		Ø8X2

Fig -4: Bill of Materials

4. FABRICATED PICK AND PLACE EQUIPMENT

Fig -5: Fabricated pick and place

5. WORKING PRINCIPLE

Stepper motor drives the ball screw by the disc coupling in the x axis and the pneumatic cylinder setup is attached to the ball screw with the suitable end effector . The pneumatic cylinder moves the end effector in the y axis.

The entire process is controlled by the sensor feedback and based on the feedback from the sensors the pick and place equipment are controlled by the plc controller. The gripper and the pneumatic cylinder is pneumatic actuated and the stepper motor is electrically actuated.

6. CONCLUSIONS

The design and fabrication of the pick and place equipment is carried out. During the testing phase the end effector reaches the desired distance. Hence the objective of designing and development of low-cost pick and place equipment and make the work place more ergonomic to the operator is carried out and implemented.

7. FUTURE SCOPE

The future scope of this project is to build the pick and place equipment with fully automation without any human intervention. After this it can be further developed with fully wireless communication.

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BIOGRAPHY

Mechanical Engineer
Area of interests are mechanical design and computational solid mechanics