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Automated System Design for Pick & Place of M/C Components of CNC-Lathe

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Abstract

Commercial and industrial pick and place systems are now in widespread use performing jobs more cheaply or with greater accuracy and reliability than humans. They are also employed for jobs which are too dirty, dangerous or dull to be suitable for humans. Pick and Place Systems are widely used in manufacturing, assembly and packing, transport, earth and space exploration, surgery, weaponry, laboratory research, and mass production of consumer and industrial goods.
Keywords: Time Window Constraint, Traveling Salesman Problem

I. INTRODUCTION

Automation is termed as use of different control systems such as numerical control, programmable logic control or other industrial control systems in concern with computer applications or information technology(such as Computer Aided Design or Computer Aided Machining) to manipulate all the industrial machinery and processes, thus reducing the need for human intervention. As always said, for growth of industries, automation is must and should supersede the mechanical growth. Where mechanization provides human operators with machinery to assist them along with the muscular requirements of work, automation decreases the involvement for human sensory and mental requirements as well. Automation plays a dominant role in the world economy these days and in daily application in industries.

II. OBJECTIVE

- To reduce lead time and trial & error method for development.
- To optimize the pick and place system design for cost.
- Evaluate the new design result with simulated data.
- Increasing productivity.
- Reducing manpower requirement.

III. LITERATURE SURVEY

A. Robotics [15]:

Automation is defined as a technology that is concerned with the use of mechanical, electronic, and computer-based systems in the operation and control of production. This technology includes transfer lines, mechanized assembly machines, feedback control systems, and robots. There are three broad classes of industrial automation: fixed automation, programmable automation, and flexible automation.

1) Robot Anatomy [15, 16]

The vast majority of today's commercially available robots possess one of the four basic configurations:
- Polar configuration
- Cylindrical configuration
- Cartesian coordinate configuration
- Jointed-arm configuration
- SCARA

Tian Huang et[11] all presents an approach for the optimal design of a 2-DOF translational pick-and-place parallel robot. By taking account of the normalized inertial and centrifugal/Coriolis torques of a single actuated joint, two global dynamic performance indices are proposed for minimization. A number of robots designed by this approach have been integrated into production lines for carton packing in the pharmaceutical industry.

H. Isıl Bozma et[12] all considers the problem of multirobot coordination in pick-and-place tasks on a conveyor band. The robot team is composed of identical robots with mutually exclusive, but neighbouring workspaces. The products are fed in one end of the band ,move through each workspace sequentially until being picked up and are collected at the other end if not picked up interim. Each robot has the same task that is picking up and packaging as many products as possible.

Yanjiang Huang et[13] all addresses the problem of realizing multi-robot coordination that is robust against pattern variation in a pick-and-place task. To improve productivity and reduce the number of parts remaining on the conveyor, a robust and appropriate part flow and multi-robot coordinate strategy are needed. By comparing it with non-cooperative game theory, we verify that the appropriate combination of part-dispatching rules is effective in improving the productivity of a multi-robot system.

M. Taylan Das et[17] all A complete mathematical model of SCARA robot (Serpent 1) is developed including servo actuator dynamics and presented together with dynamic simulation in this paper. The equations of motion are derived by using Lagrangian mechanics. Dc servo motors driving each robot joint is studied with PD controller action. Here the coordinates of pick and place points are very important for exact positioning. This is certainly performed within the tolerances given for the operation.

Istv´an Harmatia et[19] all involves a collision free target tracking problem of multi-agent robot system. Target tracking requires team coordination to maintain a desired formation and to keep team-mates and target together. Every team-mate makes decisions on their moving direction that may spoil the tactical position of others and makes the global coordination task nontrivial.

IV. DESIGN CALCULATION

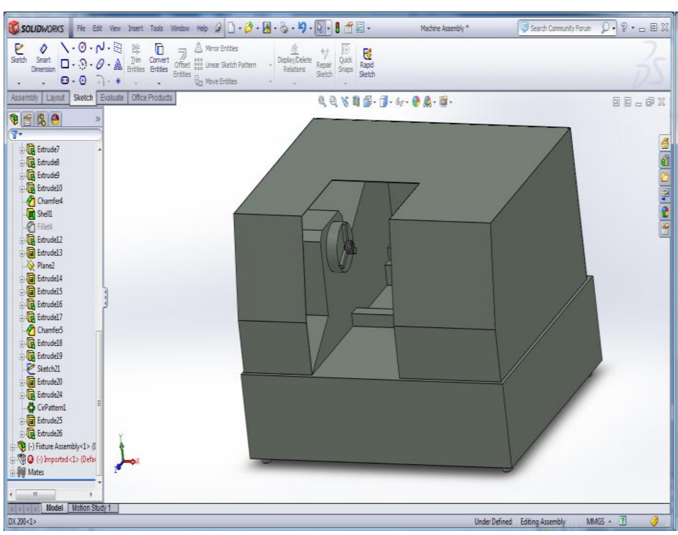
A. CNC Pick and Place Unit Consist of Below Mentioned Part:

- Pneumatic Cylinder(Loading New Component into Loading Station) :- DNC 40 MM (BORE) X 20 MM (STROKE)
- Pneumatic Cylinder(Loading Cylinder) :- DNC 100 MM (BORE) X 600 MM (STROKE)
- Pusher Pneumatic Cylinder:- DNC 32 MM(BORE) X 40 MM (STROKE)
- Unload Pneumatic Cylinder from CNC Turning Centre:- DNC 32 MM(BORE) X 40 MM (STROKE)
- Catcher Pneumatic Cylinder :- DNC 40 MM (BORE) X 500 MM (STROKE)
- Door Open and Close Pneumatic Cylinder:- DNC 63 MM(BORE) X 500 MM(STROKE)
- M.S Frame
- Two Jaw Mechanical Gripper
- Teflon Spacers

B. Cycle Time Calculation

- Total Cycle time for CNC Pick and Place Operation: - (35+7) = 42 sec
- Pick up time for raw component: - 1 sec
- Time taken to take 600 mm stroke of 100 mm Bore Cylinder: - 3 Sec
- Time taken to load raw component into fixture: - 3 Sec
- Machining time: - 35 sec

V. MODELING



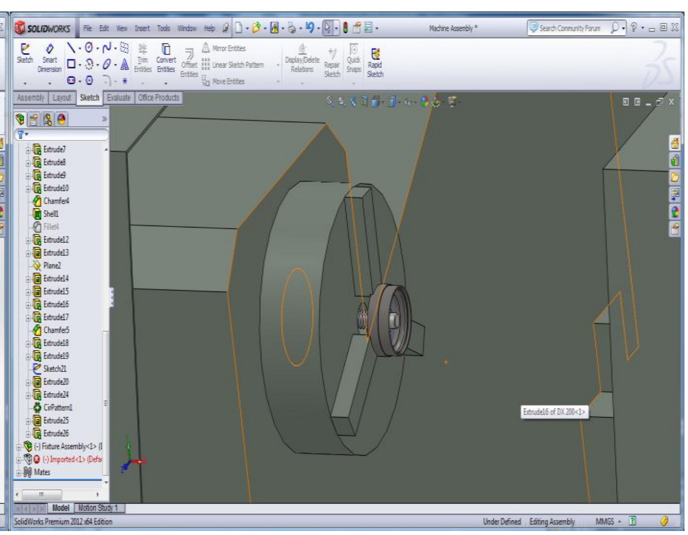


Fig. (a) CNC Turning Centre Fig.(b) Turning Centre with holding fixture

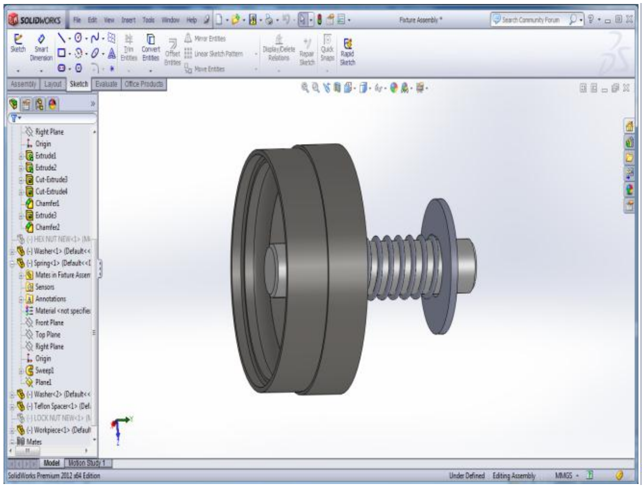


Fig. (a) Fixture with holding Workpiece

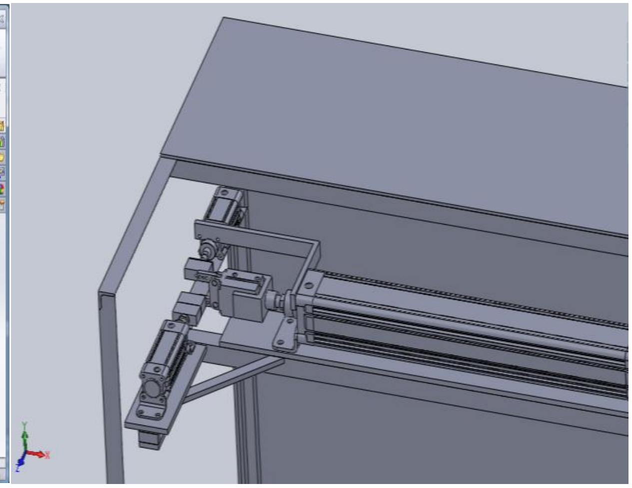


Fig. (b) CNC Pick & Place Unit

VI. FABRICATION OF CNC PICK & PLACE UNIT

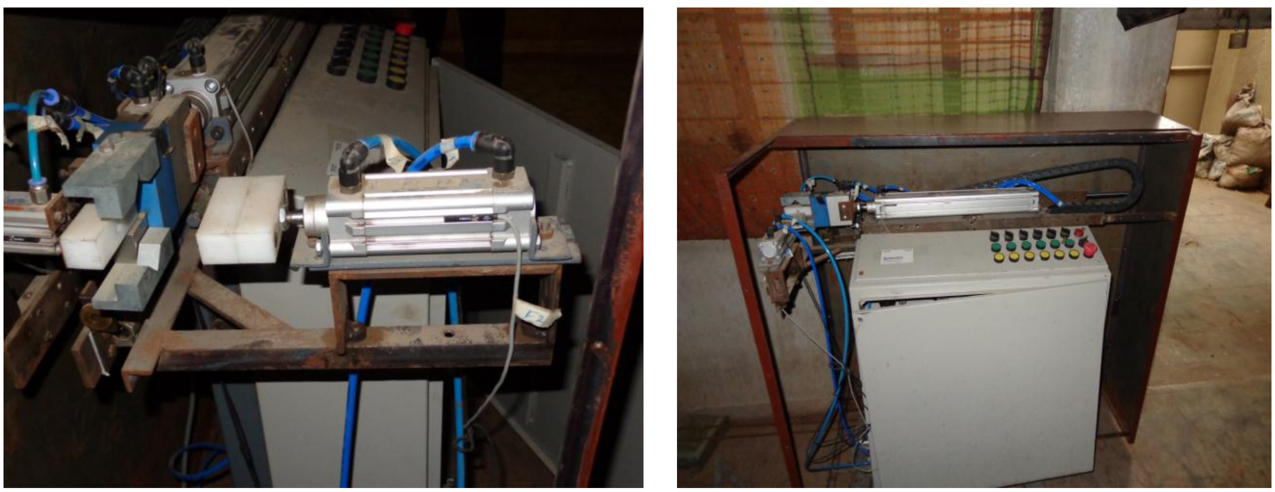


Fig. 3: Fabrication of CNC Pick & Place Unit

VII. STATIC & DYNAMIC ANALYSIS

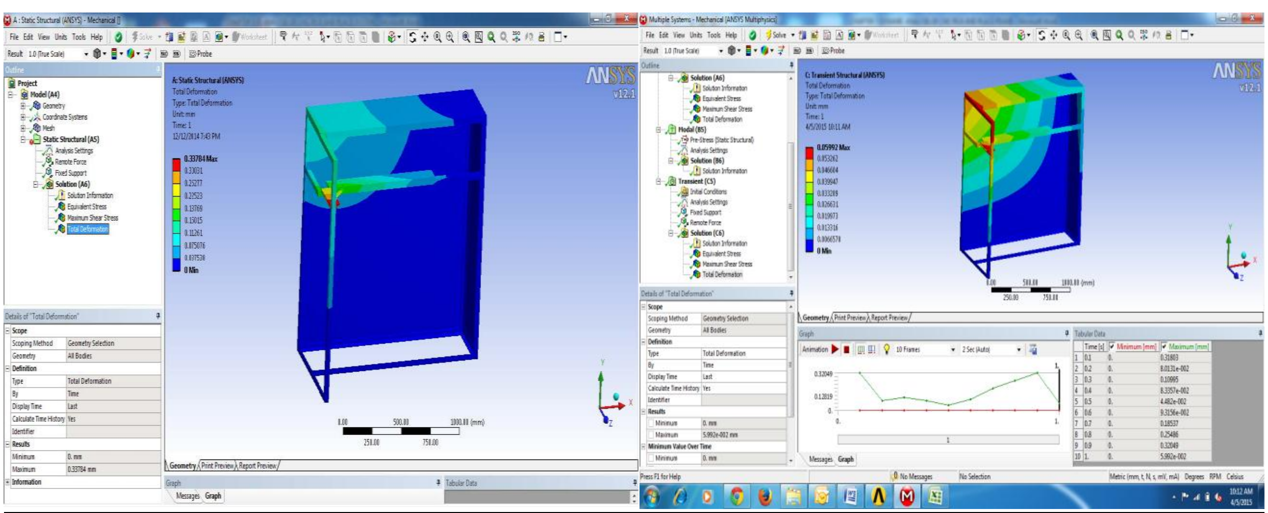


Fig. 4: Static & Dynamic Analysis

Sr No.	*Experimental Deflection*	*FE Generated Deflection*	*% Deviation*
1	*0.350 mm*	*0.33784 mm*	*3.5*

VIII. CONCLUSIONS

Some important conclusions come from this work are as under:-

1) A FEM Deflection result fairly matches with experimental work. So we can say that FE Analysis is a good tool to validate our costly experimental set up which reduces time and cost for trial and error.
2) Earlier prior to CNC Pick and Place Automation , the cycle of pick and Place carried out manually at that time loading and unloading time is 12 sec which is reduced by 7 sec by using CNC Pick and Place Automation. So productivity is increased
3) When the machine operated manually it operate hardly 12 hours per day due to labour availability. While with CNC Pick and Place unit it operates 20 hours per day.

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