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AUTOMATED ASSEMBLY SYSTEM DESIGN WITH HELP OF COMPUTER AIDED SYSTEM

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ABSTRACT The paper deal about automated assembly manufacturing cell design. First part is about Methods and techniques used for assembly systems design. Next part describes specific CAD systems used for design process of our assembly cell. With help of this CAD toll we have design geometric disposition of all system elements by CATIA and also parts of control system by FluidSim. Whole design problematic was completed by process simulation model created in Witness environment.
KEYWORDS:
Cell, design process, simulating model, computer aided design

1. INTRODUCTION

New manufacturing culture is changing the demands to the projecting works and look to the assembly research. The development of design methods and techniques of assembly processes and system is very important and necessary. Systematic approach is needed by design of assembly processes and systems. Also others aspects are influencing to the design process. Aspects such as knowledge from other research disciplines, professional creativity, tactical and strategic decision and so on. All these aspects are coming from changing technical, technological, economical and social conditions.

2. METHODS AND TECHNIQUES USED FOR ASSEMBLY SYSTEMS DESIGN

Negative aspect of design process is, that analytic and synthetic culture is not developed on good level. In generating process of assembly processes and systems are usually creating old solutions. In these days there are many methods and techniques, which can be used for solving of problems related to the designing process. These methods allow optimalizing and innovating also the assembly problems.

From verification view was our positive experiences reached in these areas:

Area	Used instrument
Graphic design	CATIA
Design and simulation of automate control system	FluidSim
Manufacturing system simulation	Witness

Aspects as high quality, short innovation cycle and other projects attributes can be attained very hard without automation projecting what means without any application of informatics and software technologies. Introduces computer aided instruments were used by design process of automated assembly cell.

3. ANALYTICAL PRINCIPLE OF MODEL DESIGN AND SIMULATION OF ASSEMBLY CELL PRODUCT BASE

The philosophy of product base design can be realized by help of synthesis process. This way can be the philosophy developed through these ways:

- variants creation based to the:

- building elements selection
- building elements combination
- selection of massive variant

- valuate accessability of solution following to the:
  - accessability range identification
  - simulating of functional activity
  - parametrical accessability decision

During the interpretation model solution process there is needed to fulfil basic conditions such as:

- to have output characteristics of element base
- to have building elements with known technical parameters
- to have technical and economical conditions of solution and realization
- to have knowledge base gull of similar solutions
- use for solution some computer aided system

By the designing process we outcome from element base of manufactured product. In assembly cell there will be assembled pneumatic linear, single acting actuators which are showed at the figure number 1.

The product consists of 5 parts. His structural piece list is showed at the figure number 2.

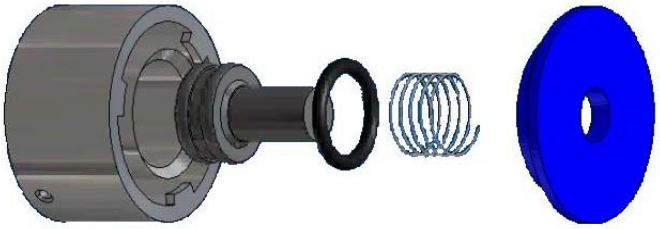


Fig. 1. The part assembled in assembly cell

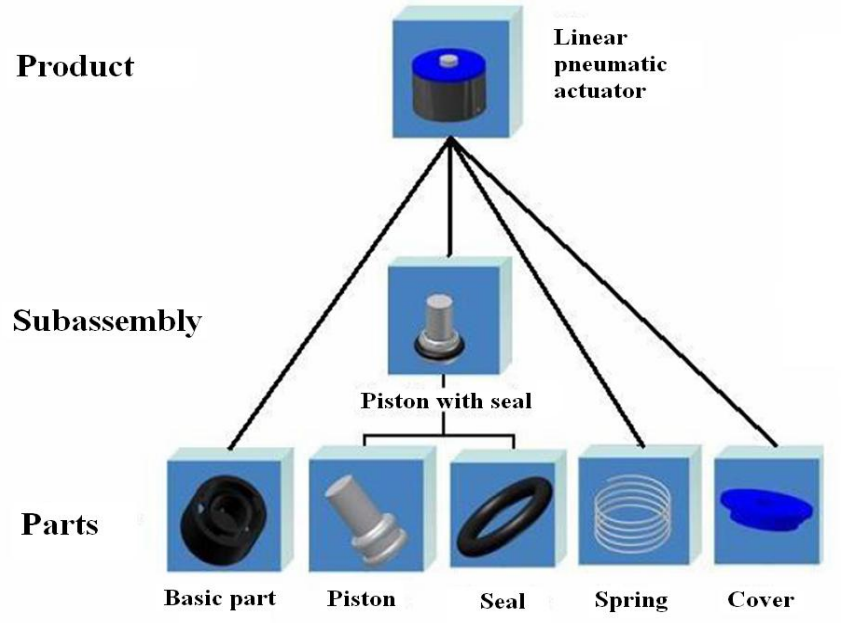
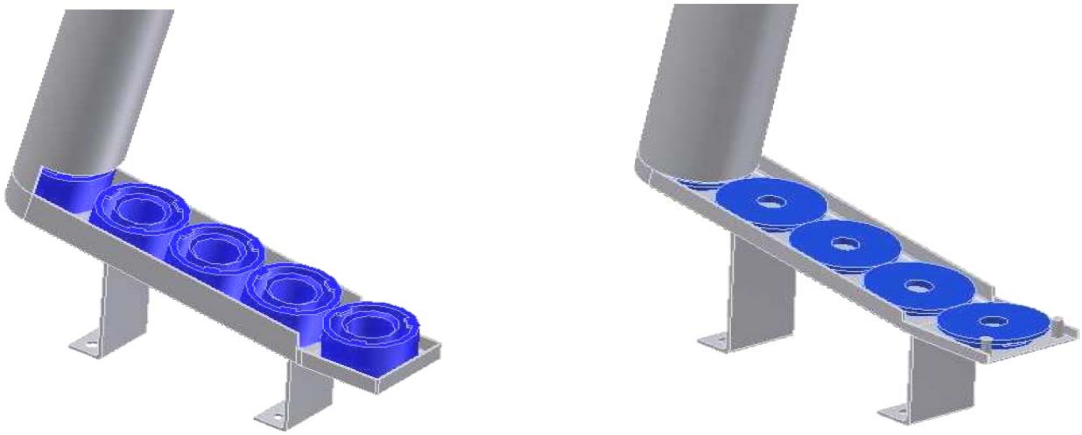


Fig. 2. Assembled product piece list

Other one request to the assembly cell was its building only from linear pneumatic driven actuators. Single actuators were following to the specification chosen from firm FESTO offer. All chosen actuators were modelled in CATIA design environment.

Same way was also modelled all buffers, one buffer for each building part of whole assembled product. Base design criteria were to use gravitational power for part movement in to the buffer. This design will provide less actuator solution. Main advantage of this kind of solution is its simplicity. For cylinder clamping was designed pneumatic driven fixture. All CATIA 3D model are showed at the figure number 3.

Whole disposition solution of assembly cell, were modelled and was also simulated. The simulation helps to eliminate possible disadvantages and negatives in the design process. This way the design problems were not influencing, and was not taking to the verification process. The simulation model of whole device is showed at the figure number 4.



a.) Gravitational cylinder buffer b.) Gravitational cover buffer

c.) Gravitational piston buffer d.) Clamping fixture

FIG. 3 Assembly cell devices – 3D models

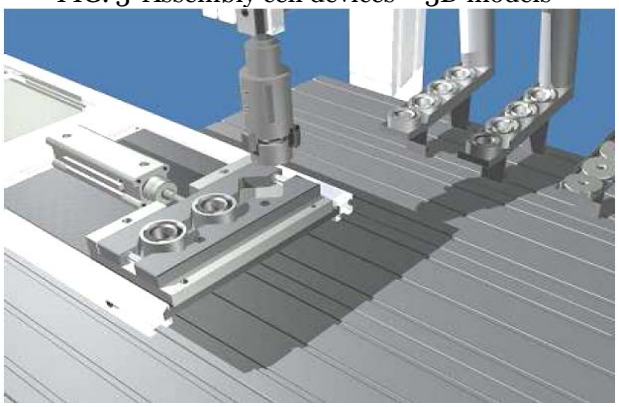


Fig. 4. Simulating model of assembly cell

4. SIMULATING MODEL CREATION OF ASSEMBLY CELL CONTROL SYSTEM

Next step of assembly cell design is to specify sensors which can be used, and which will insure back coupling in whole assembly process. Sensors and its problematic is an inseparable part of automated devices control system.

The software called FluidSim was used for creation and simulation of designed control system for assembly cell. This software allows creating some control scheme, which can be also simulated. Creation of control system scheme can be realized only after movement specification (Fig. 5).

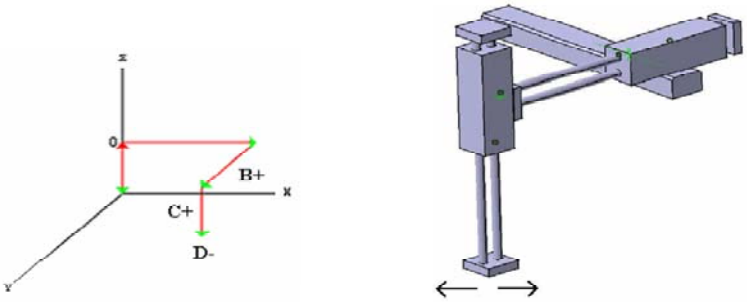


Fig. 5. Device movement analysis

Movement specification includes analyze of all device movements. Analyzed movements are then showed in diagram, which shows all movements in time steps (Fig. number 6).

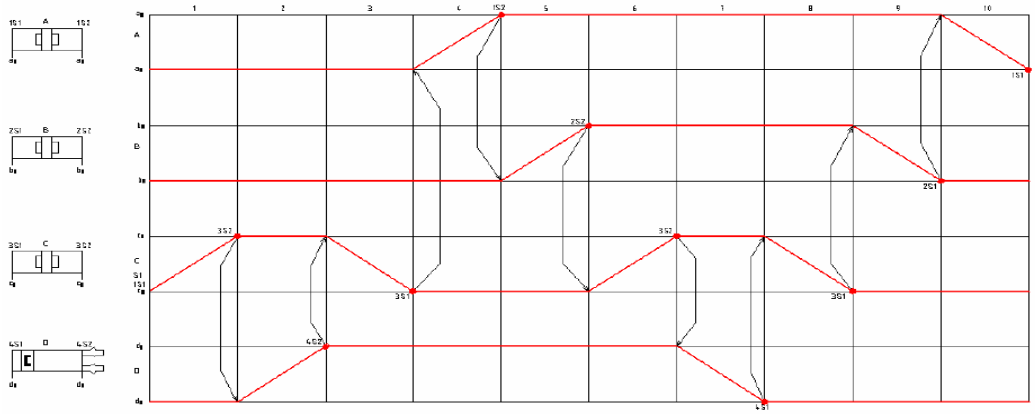


Fig. 7. Device step diagram

Outgoing to the device step diagram three control system alternatives were created. First alternative of control system used only pneumatic elements. Next alternative uses for creating of control system pneumatic components combined with tact blocks. Last one control system alternative combine pneumatic elements with electrical devices and creates simple pneumo-electric control system. Schemes of all three alternatives are showed at the figures number 8,9,10.

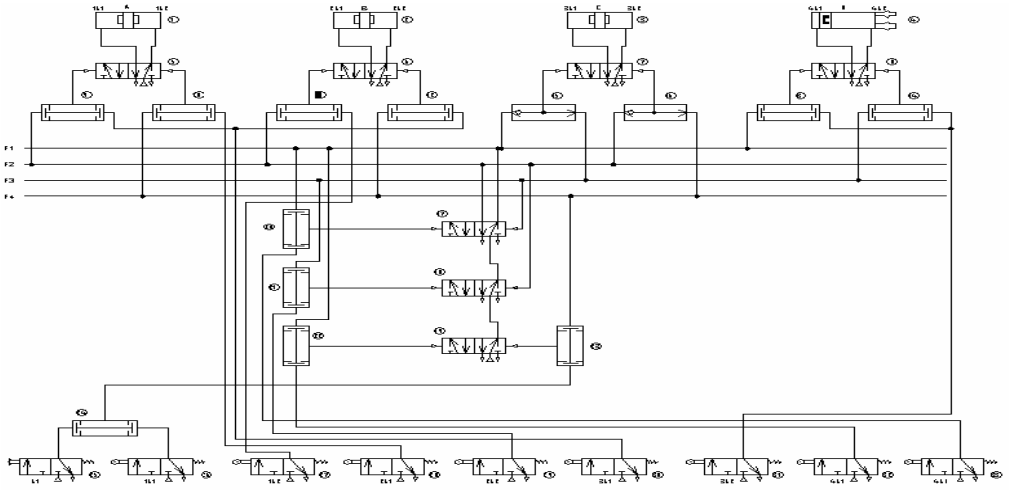


Fig. 8. Pneumatic control system – using of phases

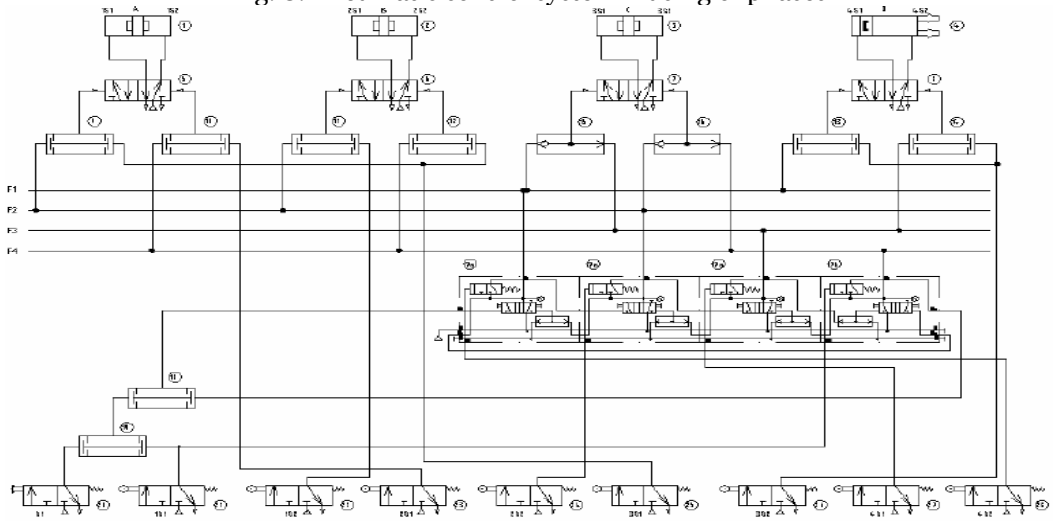


Fig. 9. Pneumatic control system – using of tact blocks

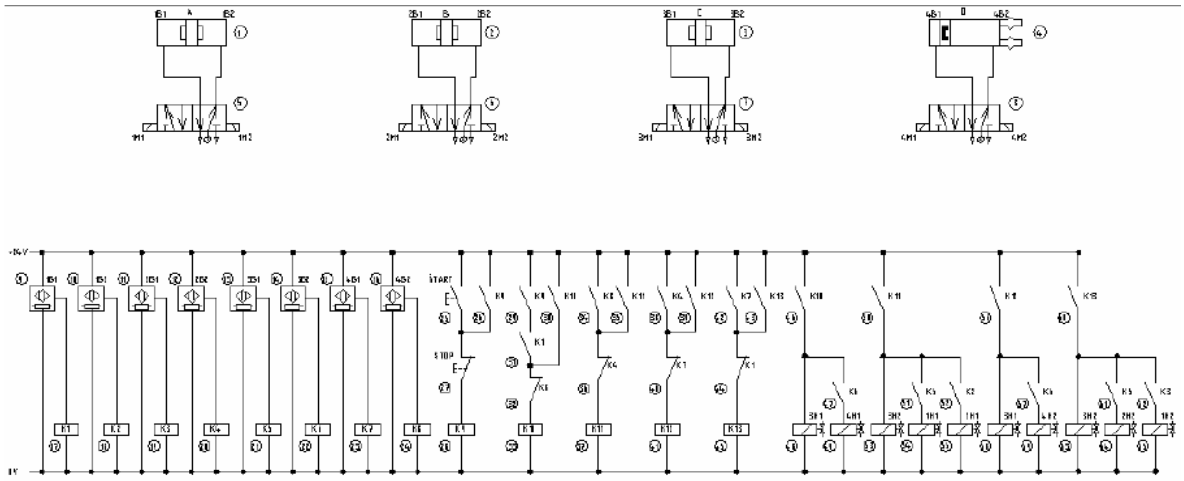


Fig. 10. Electro pneumatic control system

5. SIMULATING MODEL CREATION OF ASSEMBLY PROCESS IN TO THE ASSEMBLY CELL

Simulation can be defined as creation process of model. Model of real system which includes experiments realizations which are realized for better understanding of studied system. The system is studied for advice of various system activity variants. Simulating model is and dynamic model. In this model exists various events. These events are realized in the same order as in modelled system. Simulating methods are getting data with solving of data transformation.

This data was taken from simulating model observation. The observation activity is usually part of whole simulating model. Simulating model then gives outcomes data following to the information which are coming from time changes during the model running time. Running time is completely separated from real time in which are running the calculations.

This time separation permit to catch simulating events. Work with simulating time, design questions and model stay changes are important aspects of dynamic properties of modelled systems recording. Assembly process simulation model of our assembly cell is showed at the figure number 11.

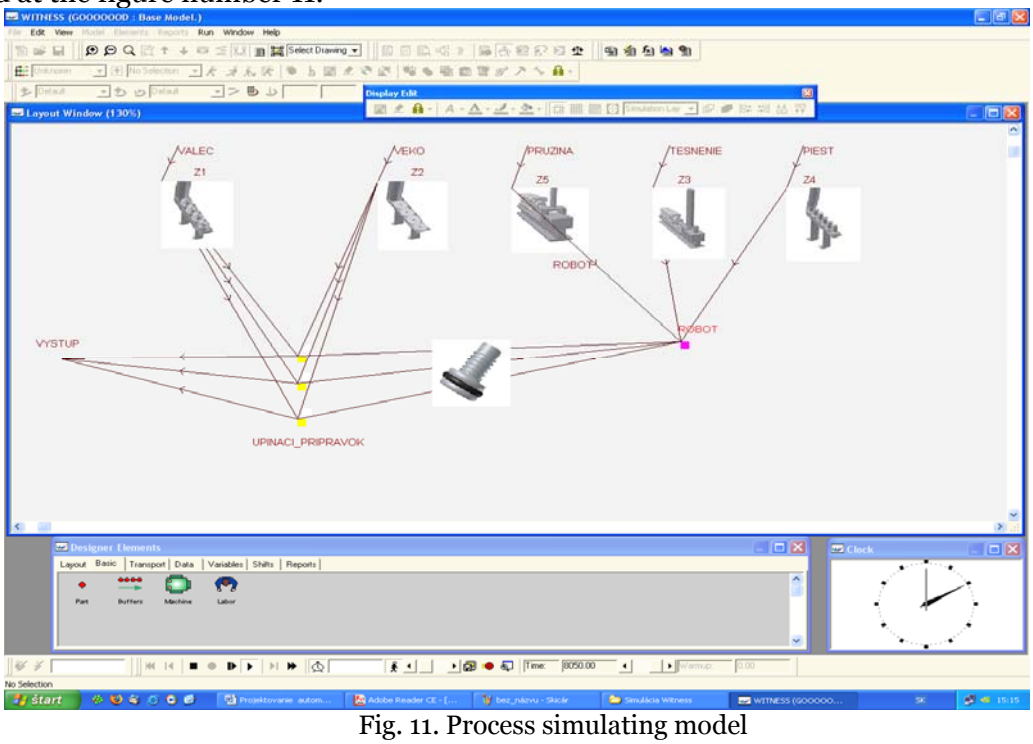


Fig. 11. Process simulating model

6. CONCLUSION

Research and realization of 3D models used for automated engineering systems, is important part of assembly systems design. Program modules of modern graphical CA system are working with high information database support, which includes elementary 3D objects used for design process of more complex models of assembly systems. Using of these types of CA systems is very important and its also short the designing time and allows possible disadvantages and mistakes and its elimination in the designing process, what save the time and also the money.

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