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COST REDUCTION THROUGH DFA ANALYSIS WITH EXPERT SYSTEM CONSTRUCTION

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Abstract

Construction of Expert system for Design for Assembly (DFA) within a concurrent engineering environment is presented in this article. The main objective of the current research work is to develop an expert system using KAPPA-PC that supports new approach for design for assembly (DFA) and to give users the possibility to assess and reduce the total production cost at an early stage during the design process. The system enables designers to minimize the number of components of a product, select the most economic assembly technique for that specific product, determine the cost and time of assembly through product analysis, and determine the design efficiency.

Keywords

Teaching tool. Concurrent Engineering, Computer-aided Design, Expert System, Design for Assembly, Object-oriented Programming.

Introduction

At present in the world there is a steady growth of demand for the new technical solutions in the field of product development and their quickest implementation in the production. In Today's competitive product market the reduction of product manufacturing costs is of a great significant. Products become more complex and highly integrated. Designers or design teams find it increasingly necessary to have a system with a common language, independent of traditional engineering disciplines. Design for assembly (DFA) is now an accepted technique and used widely throughout many large industries including GEC, Mercedes Benz, NISSAN Motors, etc. Experiences have shown that DFA analysis provides much greater benefits than simply a reduction in assembly costs. DFA is a technique that leads to significant reductions in the overall manufacturing costs. Many examples are now available which show that the product simplification brought about by DFA analysis often leads to parts cost reductions that are significantly greater than the reductions in assembly costs [1,2]. In addition, to other cost reductions which are difficult to quantify. Examples of these would be reduction

in inventory, reduction in record keeping, improvements in material flow and production flow and other benefits.

There is a need for such DFA system that enables designers / manufacturing planners to effectively analyze the ease of assembly/subassembly of the products which they design, determine the cost and time of assembly through product analysis, and determine the design efficiency, select the most economic assembly technique for that specific product, the reason that early process selection is important is that manual assembly differs widely from automatic assembly in the requirements it imposes on product design. An operation that is easy for person may be impossible for a robot or special-purpose work head, and operations that are easy for machines may be difficult for people.

The system should provide quick results and be simple and easy to implement. It should ensure consistency and completeness of the product assemblybility. It should also eliminate subjective judgement from design assessment, allow free association of ideas, enable easy comparison of alternate design, ensure that solutions are evaluated logically, identify assembly problem areas and suggest alternate approaches for improving the manufacturing and assembly of the product. The implementation of the DFA tool improves communication between manufacturing and design engineering besides keeping the record of various decisions made during the design process for future reference [3,4]. The Structure of the Proposed System consists of five modules:

1)Knowledge acquisition;
2)Knowledge representation;
3)Inference engine;
4)DFA advising module;
5)User interface.

Case study

Product simplification is achieved through the application of, our research-tested minimum part count criteria. The analysis allows you to determine the theoretical minimum number of parts that must be in the design for the product to function as required. When you identify and eliminate unnecessary parts, you eliminate unnecessary manufacturing and assembly costs. The developed 22 parts, and cost reduction of 33.78% were achieved. An example, which demonstrates the interface of Manual Assembly Analysis is shown in fig. 1.

Conclusions

During the early stages of design, control of part count is paramount to maintaining cost targets. Design for Assembly (DFA) software tools helps you

simplify products by focusing the attention of design teams on part count and part count reduction. An expert system for design for assembly has been developed in this research article. The developed system has the potential to reduce the overall product manufacturing costs. Since it advise users concerning how to minimize the number of parts of a product without any compromise on the quality. The developed prototype has been tested on a particular product and a reduction of parts number from 35 parts to 22 parts, and cost reduction of 33.78% were achieved.

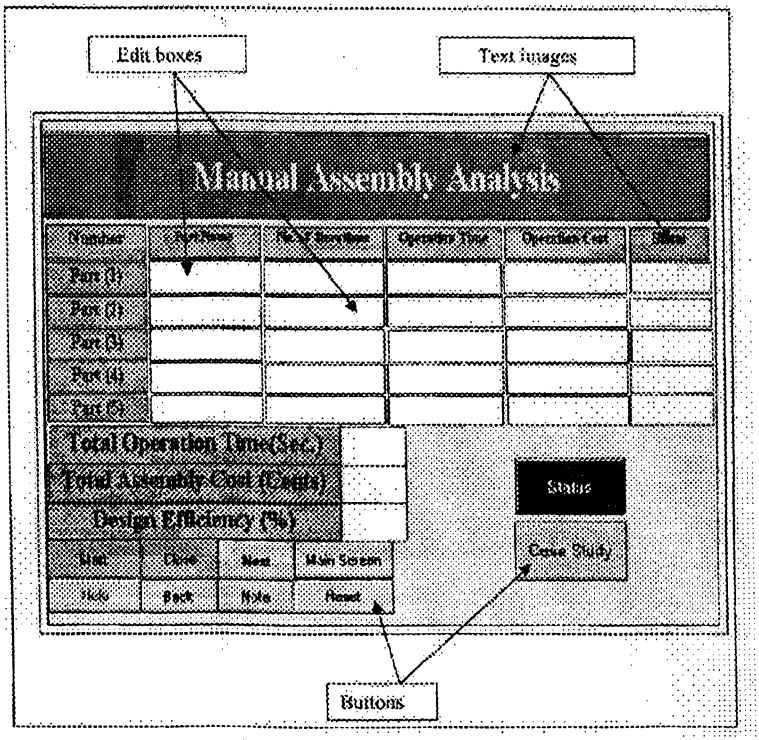

Fig. 1. The interface of Manual Assembly Analysis

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АНАЛИЗ ПРИМЕНЕНИЯ КОМПЬЮТЕРОВ ПРИ ПРОВЕДЕНИИ ЭРГОНОМИЧЕСКИХ ИССЛЕДОВАНИЙ

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Усложнение производственных процессов и оборудования изменили функции человека в современном производстве: возросла ответственность решаемых задач; увеличился объем информации, воспринимаемой работающим, и быстродействие оборудования. Работа человека стала сложнее, возросла нагрузка на нервную систему и снизилась нагрузка физическая. В ряде случаев человек стал наименее надежным звеном системы«человек-машина» (СЧМ). Возникла задача обеспечения надежности и безопасности работы человека на производстве. Эту задачу решает эргономика.

Эргономика — это наука, занимающаяся изучением вопросов оптимизации взаимодействия человека с машиной и окружающей средой в процессе жизнедеятельности, и в частности труда. Она имеет целью обеспечить удобство расположения органов управления машинами, обзорность рабочей зоны, гигиенические условия(уровень вибрации, шума, температурные условия, освещение т.д.) и др. [1].

Для эргономики характерным является системный подход к рассмотрению изучаемых процессов и явлений. Эргономика пользуется широким ассортиментом методов и конкретных методик, сложившихся в психологической науке, а также в других, смежных с нею областях(в кибернетике, физиологии и гигиене труда, математике, технических науках и др.).