A Review on Computer-aided Fixture Design

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Abstract- Fixtures are used in manufacturing process to hold, position the workpiece with respective machine tool. Fixtures are directly affect the machining quality, productivity and cost of product. In advanced manufacturing techniques, such as flexible manufacturing systems (FMS) and group technology (GT), the requirement for an efficient fixture design system is increasingly very important. The process of fixture design can be automated and integrated with other manufacturing modules, which will lead to higher productivity and shorter manufacturing lead times. In this research articles the brief review is carried out on the computer aided fixture design.

Index Terms- *CAFD, Automated fixture design*

1. INTRODUCTION

Fixtures are used in manufacturing process to hold, position the workpiece with respective machine tool. Fixture design involves locating elements to locate the workpiece properly in fixture, support pins to support the workpiece and clamping device to clamp the workpiece in proper position [2]. Fixture design can be divided into three phases: *setup planning* to determine the number of setup, the position and orientation of workpiece in each setup, *fixture planning* to determine the locating, supporting and clamping points on workpiece surfaces, and *fixture configuration design* to select or generate fixture components and place them into a final configuration to fulfill the functions of locating and clamping the workpiece [8]. The time spent on designing and fabricating fixtures significantly contributes to the production cycle in improving current products and developing new products [4]. For quality product based on accuracy and precision, an accurate fixture should be needed.

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1.1 Automated Fixture Design

Automated fixture design means a process of an appropriate fixture design without human interaction for a given workpiece. In automated fixture design, the 3D modeling software which is capable of automated fixture design and a program is needed on 3D model of the workpiece which automatically find all machining and fixturing features and extract their relevant data from the database. After that extracted data are evaluated and restructure it to match the needs of the fixture. The entities of which the workpiece geometry is constituted should be examined according to fixturing aspects such as feasibility for supporting, for positioning and/or for clamping. When appropriate base surfaces are found, the system should look for appropriate fixturing elements, place them at the proper place and in this way build a feasible fixture for the given workpiece [3].
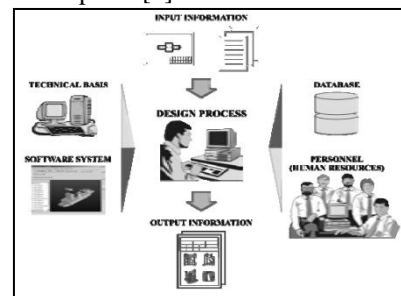

Figure 1 : General Model for Automated Fixture Design System [1]

2. LITERATURE REVIEW

Mr. Djordje and Prof. Janko [1] developed software solution in Pro/ENGINEER for the automated modular fixture design which completely satisfies set requirements. Design process has been significantly accelerated, and the degree of fixture solution has increased, which advantages to the rationalization of the design process and all the other processes succeeding as its consequence. It enables designing that is more rational by creating symbiotic type assembly, as well as efficient model generating through parameter independent construction elements.

Attila and Stampfer [3] presented the main steps that are needed for automated modular fixture design. The main steps that are needed for automated modular fixture planning and design are feature recognition, systematization of the fixturing subtasks, defining the fixturing feature determination rules, systematization

International Journal of Research in Advent Technology, Vol.5, No.4, April 2017
E-ISSN: 2321-9637
Available online at www.ijrat.org

of the modular elements, and systematization of the element selection rules.

Mr. Emad Nasr et al [4] proposed a framework for the automatic fixture design which includes fixture plan, fixture layout and fixture assembly. To achieve the integration level the artificial intelligent approach is used and for the alternative solution, a weighting factor approach is used. For validation of framework, a case study is also presented.

Segal et al [6] proposed artificial intelligence and group technology methodology for automation of modular fixture design. Artificial intelligence system is used when similar fixture designs cannot be retrieved. In this system a CAD model is given input module with necessary information. The feature regarding the CAD model automatically recognized by the system and specifies the appropriate clamping, locating and supporting points. Group technology approach resulted in the development of automated variant modular fixture design systems. In this approach, workpieces belonging to the same part family are assumed to have similar machining features and/or requiring similar operation sequences and set-ups. The retrieved fixture may be modified to suit the situation using a case-based reasoning approach.

Cecil [7] described the design approach for clamping in computer-aided fixture design by using geometric reasoning. This approach determines feasible clamp faces and positions on the given workpiece for clamping. This approach can be used for locator design to position the workpieces correctly with respect to cutting tool.

Lei and Y. Rong [10] developed *FIX-DES* system for a computer aided modular fixture configuration design system with core programs in C and C++ and interface programs in a specific CAD environment. In this system a fixture configuration will be automatically generated by selecting fixture elements from a fixture element database to form fixture units based on fixture element assembly relationships and Placing the fixture units and elements into position on a baseplate while the fixturing requirements and assembly relationships (e.g. holes alignment) are maintained.

Farhan and Majid [11] developed methodology for fixture element assembly process in modular fixtures using SolidWorks environment. This approach is based on using an expert system to achieve the correct decision of the feasible MFs layouts. For specification of the assembly model and its fixture elements to generate new models and elements automatically, the DriveWorksXpress has used. To control the design and assembly processes, a suitable rules has to create in SolidWorks.

Farhan et al [14] introduce an automated approach for assembling of modular fixtures elements by using 3D CAD software SolidWorks. Visual Basic (VB) programming language was applied integrating with SolidWorks API (Application programming interface)

functions. This integration allowed creating plug-in file and generating new menu's in the SolidWorks environment. The menu's allow the user to select, insert, and assemble MFs elements. This system can be used for a variety of work pieces and for different MFs configurations in order to achieve the feasible layout for machining operations.

Liu [16] provides a systematic design method to help dedicated fixture users to convert modular fixturing system users. This systematic design of modular fixtures helps a dedicated fixture user to build an economical and efficient modular fixturing system.

3. CONCLUSION

The presented research paper explored about review on the automated fixture design. The advanced 3D CAD software's and different methodology are used for design automated fixture design. The automated fixture design gives the position of location and clamping for the workpiece and also select proper fixturing element from the database it also gives the alternative fixture design. By using automated fixture design the product quality, short production period, cost, and efficient delivery can be achieved.

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