Design and Manufacturing of Special Purpose Machine for Parker Max Pressure Compensator Valve Automated Assembly Station

Dr. N P Sherje1, Mr. Aditya Murkute2, Mr. Piyush Patil3, Mr. Darshan Karale4, Mr. Kaustubh Vade5,
123UG Student, B.E. Mechanical Engineering, Smt. Kashibai Navale College of Engineering, Pune

Abstract- Compensator valve objective is it could be used either with fixed or variable orifice and maintains a constant flow. The basic construction of compensator valve is a two way valve with components needed to be assembled in both sides of valve body. As the assembly of compensator valve is complicated and time consuming, for accurate assembly purpose special purpose machine is designed which allows us semi-automated assembly of this compensator valve. The main objective for designing special purpose machine is to increase productivity, reduce maintenance cost and to make assembly simple.

1. INTRODUCTION

Broadly the special purpose machine tools could be classified as those in which jobs remain fixed in one position and those in which job moves from one station to other (Transfer machine). In first case the machine may perform either only one operation or more. In the second case, the product may be either moving continuously (as in the case of spraying, polishing, sanding etc) or intermittently (the most usual case in machining operation). An automated workstation for a pre-decided component assembly is to be done in this case. Automated assembly stations are very popular production machine and is described in brief below. Special purpose machines are in demand because they do the job they are created for more efficiently when compared against mass produced machines available in the market.

It is essential that all movements be completely synchronized in order to obtain desired product it is essential that all tools and units must have completed their operation and be withdrawn clear of the turret before it starts to index similarly the turret index precisely and come to rest before tools and units begin their work. The basic aim of designing this kind of Special purpose machine is to accomplish the complete assembly of the compensator valve. The assembly of the compensator valve is supposed to be semi-automated. As per the requirements and considering the basic parameters of the compensator valve, further designing was implemented.

2. LITERATURE REVIEW

2.1 Human-Computer Interaction Based on Hand Gestures Using RGB-D Sensors

Author: Jose Manuel Palacios, Carlos Sagues, Eduardo Montijano and Sergio Llorente.

This Paper states about the sensors used for hand gestures using RGB-D sensors. The proposed approach takes advantage of depth information to cope with the most common problems of traditional video-based hand segmentation methods: cluttered back grounds and occlusions. The algorithm also uses colour and semantic information to accurately identify any number of hands present in the image. Ten different static hand gestures are recognized, including all different combinations of spread fingers. Additionally, movements of an open hand are followed and 6 dynamic gestures are identified. The main advantage of our approach is the freedom of the user’s hands to be at any position of the image without the need of wearing any specific clothing or additional devices. Besides, the whole method can be executed without any initial training or calibration. Experiments carried out with different users and in different environments prove the accuracy and robustness of the method which, additionally, can be run in real-time.

2.2 Robust design of fixture configuration

Author: Giovanni Moronia, Stefano Petro a, Wilma Polinib

This Paper states that the paper deals with robust design of fixture configuration. It aims to investigate how fixture element deviations and machine tool volumetric errors affect machining operations quality. The locator position configuration is then designed to minimize the deviation of machined features with respect to the applied geometric tolerances. The proposed approach represents a design step that goes further the deterministic positioning of the part based on the screw theory, and may be used to look for simple and general rules easily applicable in an industrial context. The methodology is illustrated and validated using simulation and simple industrial case studies. When a workpiece is fixtured for a machining or inspection
operation; the accuracy of an operation is mainly determined but the efficiency of the featuring method. In general, the machined feature may have geometric errors in terms of its form and position in relation to the workpiece datum reference frame. If the exists a misalignment error between the workpiece datum reference frame and machine tool reference frame, this is known as localization error or datum establishment error.

2.3 Jig and Fixture Design
Author: Hamad Mohammed Abouhenidi.

This Paper states the principle used for designing of jigs and fixtures. The idea for designing the rigid framework was done by proper jigs and fixtures. The successful running of any mass production depends upon the interchangeability to facilitate easy assembly and reduction of unit cost. Mass production methods demand a fast and easy method of positioning work for accurate operations on it. Jigs and fixtures are production tools used to accurately manufacture duplicate and interchangeable parts. Jigs and fixtures are specially designed so that large numbers of components can be machined or assembled identically, and to ensure interchangeability of components. Jigs is a work holding device that holds, supports and locates the workpiece and guides the cutting tool for a specific operation. Jigs are usually fitted with hardened steel bushings for guiding or other cutting tools. a jig is a type of tool used to control the location and/or motion of another tool.

3. PROBLEM DEFINITION
Nowadays demand for any product is increasing because of increasing population in our country. To maintain this balance industries are increasing production rates of these products but as humans have limitations and also lack in efficiency a Special Purpose Machine (SPM) needs to be designed and manufactured to automate the production line.

4. METHODOLOGY
1. Commencement of project
2. Brainstorming
3. Finalization of general structure of machine
4. Designing of components and structural elements.
5. Final design of project.
6. Analysis of models.
7. Final project.

4.1 Commencement of project:
Once the purpose of assembly was clear, the fixture for mounting of compensator valve would be designed accordingly. Locator pins are used as a basic fixture for locating the upright position. Further, the process of articulation was done using a simple rotary motor for the two-way assembly. Thus, the use of mechanical setup will make the system economical and will also assure the longevity of the system.

4.2 Specify Requirements:
The shaft holding fixture for the assembly should articulate 180 degree for the two-way assembly of the valve. Proximity sensors should be placed accordingly and circuitry should be maintained properly. Locating pins should be placed in such a way that it upholds the valve in an upright position and maintains a firm hold. Torqueing of Stud bolt and lock nuts is necessary and both should be torqued at 68 Nm and 4 Nm respectively.

4.3 Brainstorming:
The major issue while assembling the valve was to locate it while considering the ease of operator, sequence of assembly. We had two options for locating the valve, first using palate configuration and second is with locating pins. Using the locating pins was our primary conclusions of these sessions. There are two stages of the assembly process i.e one with the valve upright and second is by rotating it by 180 degrees. To rotate this, we concluded to use a Bonfiglioli motor which consists of a worm type gearbox. Finalizing the actuators, sensors, were among the many outcomes of these sessions.

4.4 Finalise an Idea:
Considering the constraints of space, orientation of the shaft, the idea of making use of a Bonfiglioli motor was finalised. Choosing the sensors and actuators was decided according to the operation and space constraints. The advantage of using these was the smooth and noiseless operation. The required torque guns were finalized considering the torquing values.

Figure 1. Exploded view of compensator valve
5. DESIGN OF SPECIAL PURPOSE MACHINE

For the design of special purpose machine the required products were listed. Further for selection of materials the analytical calculations for bearings, actuators and torque gun were finalized. For the designing of rigid frame work simple jigs and fixture were used and material for rigid frame work was mild steel 40mm x 40mm square pipe with 2mm thickness. The operating height for machine was decided 1000mm so that every worker may be compatible to work in any environment. The base and top of rigid frame work was selected bolted so that it can be easily removable and easy access to worker. The placement of components was selected so that it can be easily accessible to worker.

![Figure 2. Rigid framework.](image)

After further selection of materials their cad drawing was drafted and their positions were decided. The sub-assembly mountings were done on rigid framework. Torque gun placement, bins placement and motor placement was done on right side. In the center part compensator valve assembly was placed with actuators and proximity sensors with bar code scanner. The barcode scanner was selected so that on each compensator valve a separate barcode will be placed so that time required for assembly will be calculated. On the left side the electricals mountings, computer placement, bins and power board is mounted. The lower side of frame work has electrical bank placement which has circuits used for electrical sensors. This electrical bank mounting is kept lower so that the wires and cables will not make complicate assembly station. The MCB switch is given in power bank to avoid short circuit.

![Figure 3. Proposed work station.](image)
6. ASSEMBLY SEQUENCE OF COMPENSTOR VALVE

7. REFERENCES


3. Hamad Mohammed Abouhenidi, “Jig and Fixture Design”


6. J. Do Mowison John F, “Corrosion Study of Bare I. And Coated Stainless Steel”


9. Giovanni Moronia, Stefano Petro a, Wilma Polinib, “Robust design of fixture configuration”