Design and Fabrication of Automatic Tool Retrieval System for Machining Process

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Abstract-*In this work, design and fabrication of a device for the purpose of tool retrieval system. In many industries even now the tool are carried by tool room manually. Due to this manual process in industries there is wastage of money and time. In order to avoid this wastage this project has been implemented to design a model called as the tool retrieval system. This is an advanced and easy process to get the tool from the tool box. In this process electrical supply is used to operate the device. This model has the following parts in it- a tool box, a micro control with separator arrangement, and a motor arrangement. Tool retrieval is the activity of obtaining different tool from a collection of different resources. Automated tool retrieval systems are used to reduce the time duration and increase the productivity. This is very useful for all mechanical workshop and industries to do bulk production of different products.*

Keywords: Automation, Tool Retrieval, Production

I. INTRODUCTION

This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased. Degrees of automation are of two types, viz. Full automation and Semi automation. In semi automation a combination of manual effort and mechanical power is required whereas in full automation human participation is very negligible.

II. WORKING PRINCIPLE

A Motor is fixed at the bottom of the tool box. It is used to rotate the tool box. Different tools and raw materials are kept in this tool box. Microcontroller is used to operate the motor so that the required tool or raw materials are easy to gettable. Keypad is used to select the tool or raw materials to be needed, the control signal are given to the microcontroller unit. Microcontroller is activating the corresponding motor so that required tool or raw material box comes to our side automatically. The components are used in this project are D.C motor, microcontroller unit, gear wheel.

The above mentioned prats are used for various purposes in this model to operate it. A reduction gear arrangement is fixed for the slow rotation of the tool box as shown in the figure. When the key is get pressed in the number order of tool box. Then the microcontroller recieves the signal and activates the motor. Now the reduction gear arrangement drives the tool box. A micro D.C motor is fixed at the top of the tool box. The control unit activates the micro motor also in a timing manner. This motors shaft is connected to the door of tool box for open and close.

III. ELEMENTS OF TOOL RETREVAL SYSTEM

The Automatic Tool Retrieval System consists of the following components to fulfill the requirements of complete operation of the machine.

1) D.C Motor
2) Tools Box
3) Bearing
4) Gear
5) Micro Controller Unit
6) Battery
7) Stand

3.1 D.C. MOTOR (PERMANENT MAGNET)

An electric motor is a machine which converts electrical energy to mechanical energy. Its action is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a magnetic force whose direction is given by Fleming's left hand rule.

3.2 TOOLS BOX (CABIN)

A toolbox (also called toolkit, tool chest or workbox) is a box to organize, carry, and protect the owner's tools. They could be used for trade, a hobby or DIY, and their contents vary with the craft of the owner.

3.3 BEARING WITH BEARING CAP

The bearings are pressed smoothly to fit into the shafts because if hammered the bearing may develop cracks. Bearing is made upon steel material and bearing cap is mild steel.

3.4 GEARS

Gears are commonly used to transmit rotational motion between machinery shafts. When gears of different types and sizes are combined, they can change the rate of rotation, the direction of the axis of rotation, and change rotary motion to linear motion.

3.5 MICROCONTROLLER UNIT

In our project 89C52 Microcontroller is used as a control unit.A microcontroller consists of a powerful CPU tightly coupled with memory (RAM, ROM or EPROM), various I/O features such as serial port(s), parallel port(s), Timer/Counter(s), Interrupt controller, Data Acquisition interfaces-Analog to Digital Converter (ADC), Digital to Analog Converter (DAC), everything integrated onto a single silicon chip.

3.6 STAND:

This is a supporting frame and made up of mild steel to hold all machine elements for functioning.

IV. ENGINNERING DESIGN

Initially, Creo Elements/Pro offers a range of tools to enable the generation of a complete digital representation of the product being designed. In addition to the general geometry tools there is also the ability to generate geometry of other integrated design disciplines such as industrial and standard pipe work and complete wiring definitions. Tools are also available to support collaborative development.

A number of concept design tools that provide up-front Industrial Design concepts can then be used in the downstream process of engineering the product. These range from conceptual Industrial design sketches, reverse engineering with point cloud data and comprehensive free-form surface tools

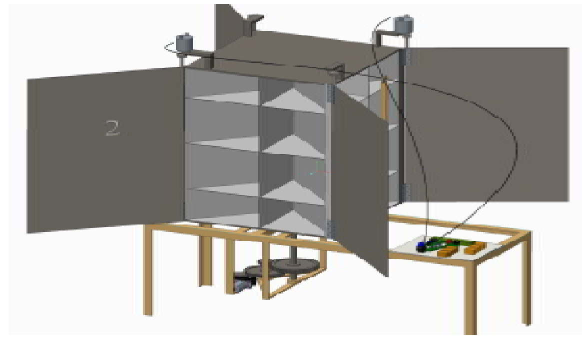

Figure 4.1 Slots for material and Tools

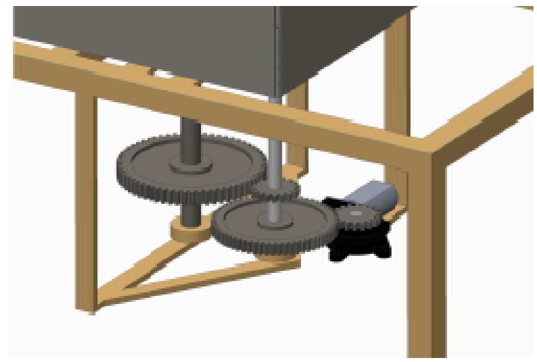

Figure 4.2 Gear Mechanism

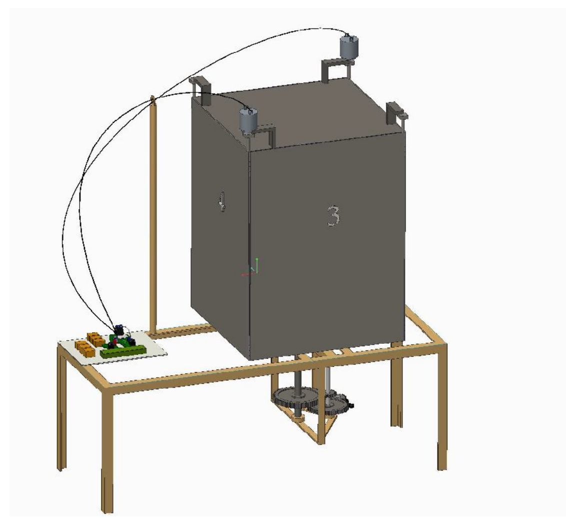

Figure 4.3 Circuit view

V. MANUFACTURING PROCESS

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are then modified through manufacturing processes to become the required part. Manufacturing processes can include treating (such as heat treating or coating), Machining, or reshaping the material. The manufacturing process also includes tests and checks for quality assurance during or after the manufacturing, and planning the production process prior to manufacturing.

VI. DESIGN CALCULATION

6.1 DESIGN OF BALL BEARING

Bearing No. 6204
Outer Diameter of Bearing (D) = 47 mm
Thickness of Bearing (B) = 14 mm
Inner Diameter of the Bearing (d) = 25 mm
r = Corner radii on shaft and housing
r = 1 (From design data book)
Maximum Speed = 14,000 rpm (From design data book)
Mean Diameter (dm) = (D + d) / 2
= (47 + 25) / 2
dm = 36 mm
Spring index (C) = (D /d)
= 12 / 2
C = 6

6.2 WALL STRESS FACTOR

Ks = $\frac{4C - 1}{4C - 4\ C}$ + 0.65
= $\frac{(4 X 6) -1}{(4 X 6)-4\ 6}$ + 0.65
Ks = 1.258

6.3 DESIGN OF SPUR GEAR

Number of teeth = 60
Overall diameter = 62 x Module
= 62 x 1
= 62 mm
Pitch diameter = 60 x Module
= 60 x 1
= 60 mm
Depth = 2.157 x Module
= 2.157 x 1
= 2.157 mm
Pressure angle = 14½°

6.4 DESIGN OF RACK

Pitch circle diameter of the gear is = 45 mm
Circumference of the gear is = pitch circle diameter
= 45
= 141.38mm
The dimension is for 360 for one rotation
For two rotations (Approx.) the rack minimum length is 141.38 mm

6.5 SPECIFICATION OF RACK

Minimum length of the teeth : 141.38 mm. Here : 215 mm used.
Material : cast iron
Module : 1.5mm
Cross-section : 20 15mm
Teeth on the rack is adjusted for 215mm

6.6 DESIGN OF D.C. MOTOR

POWER RATING OF THE MOTOR:
Torque at motor sprocket = 17.633 N-m
Torque at the reduction gear = 5.289 N-m
Power of the motor=Torque x (2 x 3.14 x N) / 60
= (5.289 x 2 x 3.14 x 650) / 60
= 360 Watts
= 360/735.5
= 0.49 H.P 0.5 H.P

6.7 TORQUE IN THE MOTOR

For an armature of a motor, to rotate about its centre, a tangential force is necessary. This force is developed with in the motor itself.

Torque (T) = ½ (Ia / A) BDC Z Newton meters

Using the relation,
B = φ / a
= φ / (Π D / P) ł
= φ x P / (Π Dł)
T = ½ x (Ia / A) x Z x φ x {P/ (ΠDł) } x Dł
= φ Z P Ia / (2ΠA) Newton meters
= 0.159 x φ x Z x Ia X (P/A) Newton meters
= 0.162 x φ x Z x Ia x (P/A) Kg-m

The torque given by the above equation is the developed torque in the machine. But the output torque is less than the developed torque due to friction and wastage losses.

VII. INSPECTION

Critical appraisal involving examination, measurement, testing, gauging, and comparison of materials or items. An inspection determines if the material or item is in proper quantity and condition, and if it conforms to the applicable or specified requirements. Inspection is generally divided into three categories: (1) Receiving inspection, (2) In-process inspection, and (3) Final inspection. In quality control (which is guided by the principle that "Quality cannot be inspected into a product") the role of inspection is to verify and validate the variance data; it does not involve separating the good from the bad .

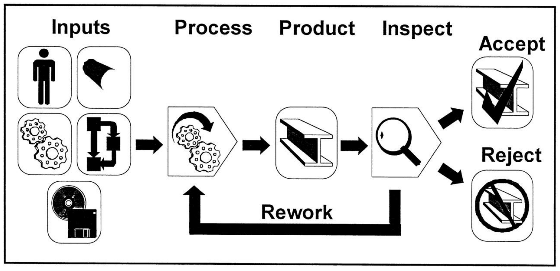

Figure7 Inspection Process

VII. ASSEMBLY

An assembly line is a manufacturing process (most of the time called a progressive assembly) in which parts (usually interchangeable parts) are added as the semi-finished assembly moves from work station to work station where the parts are added in sequence until the final assembly is produced. By mechanically moving the parts to the assembly work and moving the semi-finished assembly from work station to work station, a finished product can be assembled much faster and with much less labor than by having workers carry parts to a stationary piece for assembly.

IX. APPLICATIONS, MERITS AND DEMERTS

9.1APPLICATION

- Small and Medium scale industries
- It is very useful in machine shop
- Industrial Application

9.2LIMITATIONS

- Additional cost is required to do automation
- Load carrying capacity of this unit is not very high

9.3 ADVANTAGES

- High production
- Low man power required
- Quick response is achieved
- Simple in construction
- Easy to maintain and repair
- Cost of the unit is less when compared to other robotics
- No fire hazard problem due to over loading
- Comparatively the operation cost is less
- Continuous operation is possible without stopping

X. CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. Lots of practical knowledge regarding, planning, purchasing, computing and machining has been gained while doing this project work. This project work is a good solution to bridge the gates between institution and industries.

The tool retrieval system is working with satisfactory conditions. Lots of things such as understanding the difficulties in maintaining tolerances and quality were learned. This project will reduce the cost involved in the concern. Project has been designed to perform the entire requirement task at the shortest time available.

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