

Ball Bearing Stacking Automation System

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Abstract — This document is an effort to introduce the concept of automation in small scale industries and or small workshops that are involved in the manufacturing of small objects such as nuts, bolts and ball bearing in this case. This an electromechanical system which includes certain mechanical parts that involves one base stand on which one vertical metallic frame is mounted and hinged to this vertical stand is an in humanized effort seems inadequate in this era making necessary the use of Electronics, Computer in the manufacturing processes leading to the concept of Automated Manufacturing System (AMS). The ball bearing stack automation is an effort in this regard.

In our project we go for stack automation for any object for example a ball bearing, be that is still a manual system there. It will be microcontroller based project control system equipped with microcontroller 89C51 from any manufacturer like Atmel or Philips. This could have been easily implemented if a PLC could be used for manufacturing the staking unit but I adopted the microcontroller based system so that some more modification in the system can be effected at will as to use the same hardware. Although a very small object i.e. ball bearing or small nut and fixture will be tried to be stacked, the system with more precision and more power handling capacity could be built for various requirements of the industry. For increasing more control capacity, we can use another module of this series. When the bearing is ready, it will be sent for packing. This is sensed by an inductive sensor. The output will be proceeds by PLC and microcontroller card which will be driving the assembly in order to put it into pads or flaps.

This project will also count the total number of bearings to be packed and will display it on a LCD for real time reference and a provision is made using a higher level language using hyper terminal of the computer.

Keywords — Concept of Automation, Carriage Assembly, Proximity Sensor, Solenoid Valve Microcontroller and its Action, Common Port, Assembly Language Programming, VB.0 Assembly Language and Finally Interfacing of the Carriage Assembly with The Computer.

I. INTRODUCTION

Automation focuses on the use of control systems (such as numerical control, programmable logic control, and other industrial control systems), in association with other applications of information technology (such as computer-aided technologies [CAD, CAM, CAX] to control industrial machinery and processes, reducing the need for human beings cumbersome efforts. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provided human operators with machinery to assist them with the muscular requirements of work, automation greatly reduces the need for human sensory and mental requirements as well. Processes and systems can also be automated.

Automation plays a vital role in the global economy and in daily experience. Engineers strive to combine automated devices with mathematical and organizational tools or models to create complex systems for a rapidly expanding range of applications and human activities.

Many roles for humans in industrial processes presently lie beyond the scope of automation. Human-level pattern recognition, language recognition, and language production ability are well beyond the capabilities of modern mechanical and computer systems. Tasks requiring subjective assessment or synthesis of complex sensory data, such as scents and sounds, as well as high-level tasks such as strategic planning, currently require human expertise. In many cases, the use of humans is more cost-effective than mechanical approaches even where automation of industrial tasks is possible.

Specialized hardened computers, referred to as programmable logic controllers (PLCs), are frequently used to synchronize the flow of inputs from (physical) [HYPERLINK http://en.wikipedia.org/wiki/Sensor](http://en.wikipedia.org/wiki/Sensor) sensors and events with the flow of outputs to actuators and events. This leads to precisely controlled actions that permit a tight control of almost any industrial process.

Human-machine interfaces (HMI) or computer human interfaces (CHI), formerly known as man-machine interfaces, are usually employed to communicate with PLCs and other computers, such as entering and monitoring temperatures or pressures for further automated control or emergency response. Service personnel who monitor and control these interfaces are often referred to as stationary engineers.

II. OBJECTIVES

The main objective of this project is to stack the objects coming at the outlet of any manufacturing unit in this case I have taken the example of ball bearing that are available at the outlet of say a bearing manufacturing machine. Initially the tray in which the bearings are to be tacked is kept at a predefined reference level either in X or Y direction. The first object will be put at the reference position. It will be counted and the display will show reading 1. Proper time delay will be given until the next bearing comes. No sooner the next bearing comes at the outlet of the machine, the tray is kept in the same position. The movement of the tray either in X direction or in the Y direction should start only when the arrival of new object is sensed with the help of proper sensor. Not with human hand. So, that the inductive sensors is used to detect the only the Metal so that the shift in the reference position can be initiated.

Since if there is some problem in position shifting of the tray due to hard stroke of the pneumatic cylinder, the movement of the stroke can be regulated using flow control valve of the air so there should be control of flow of air so that there is a smooth movement of the carriage assembly or tray is ensured. A common air compressor can be used as a pneumatic. As a result after the completion of a cycle at least four bearings can be stacked in this demonstration model.

2.1 Necessity

In order to deal with outsourcing, companies have found it necessary to decrease costs in production. The solution for this issue is to automate the process to improve efficiency and decrease number of labours. Customers want higher productivity and more automation, so pallet systems are more popular. Demands for lights-out and lean production and overall there is high pressure for machines that reduce labour costs and out-of-cut time. Reaction to globalization, particularly to developments in China has forced US manufacturers to search for ways to reduce costs. That in turn has seen a move to more automation to reduce setup time and labour cost, and increase quality. The next higher level of automation would be an integrated system such as an HMC in a cell configuration with automated loading and unloading. The next approach is to add automated featuring. Our newest control offering is a highly integrated, network-based control, so automation is more easily achieved. In the future, we may see more fixture automation. It has now become a norm, i.e. the more the automation the more will be the throughput.

III. SYSTEM DESIGN

3.1 The Inductive Proximity Sensor

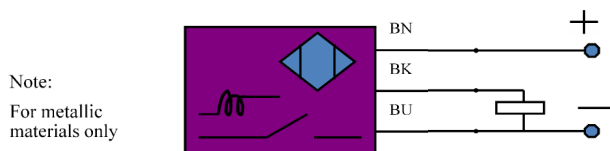


Fig.1. Proximity sensor working

Operating principle is based on a coil and oscillator that creates an electromagnetic field in the close surroundings of the sensing surface.

When the detecting distance is one inch or less and your application calls for metal sensing, the inductive proximity sensor provides the needed sensing solution. The inductive proximity sensor [1] choice seems natural due to its rugged metal housing and enclosed internal circuitry. The proximity sensors epoxy potting makes the inductive device superior to other sensing technologies when the environment is harsh like those found in machine tool sensor applications where dust and dirt build up are an issue. Additionally, the inductive proximity sensor is currently the best selling sensing technology worldwide, so you know that it has been well proven.

3.2 The carriage assembly

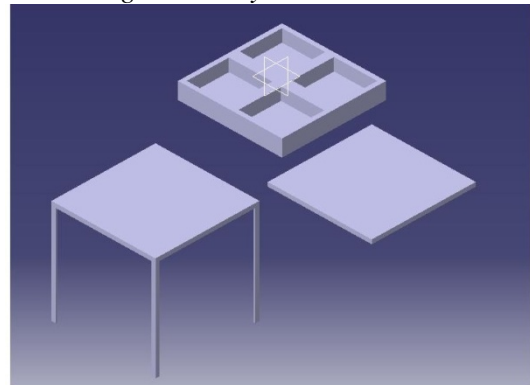


Fig.2. Parts of Carriage Assembly

The above figure shows the various parts made from mild steel that will be suitably assembled in order to form the carriage assembly. Suitable machining and fabrication techniques [8] have been applied. Proper utilization of welding technology is done in order to assemble a rigid and solid carriage assembly. It involves arc welding technique so that enough strength could be provided in order to withstand the power delivered by the pneumatic cylinders. It shows a conceptual view of the various parts of the carriage assembly.



Fig.3. The actual photograph of carriage assembly

However a typical assembly is also there which is shown in the following figure. The two pneumatic cylinders are also shown and the inclined bar is the guided path through which the bearing or the object manufactured is guided down to the reference position of the carriage assembly's tray

The materials chosen for the above mentioned automated or semi automated assembly All paragraphs must be indented. All paragraphs must be justified, i.e. both left-justified and right-justified.

3.3 The Pneumatic cylinder

The pneumatic cylinder deployed here is a double acting cylinder [2]. It works on air as the air is most common medium for displacement operations. The bore diameter is around 25mm and the distance to be moved is in between 80 mm to 100 mm. The figure shown below sketches the assemble part of compressed air supply to the pneumatic cylinder. Also for regulated air flow, flow control valves can be used.

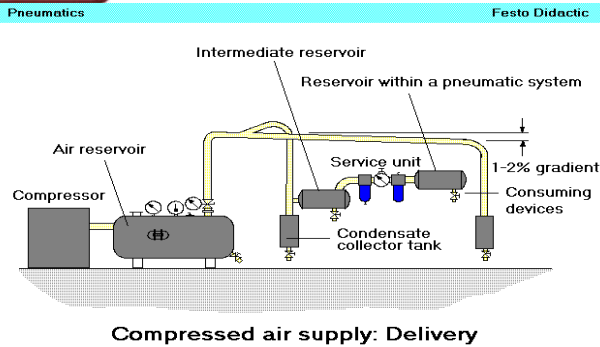


Fig.4. Compressed air supply to pneumatic cylinder

The thrust generated by a double acting cylinder is given by

$$F = (\pi \times D \times P) \ 4$$

Where

F is cylinder thrust in Kg

D is the diameter of the piston in cm

And P is operating Pressure in "Bar".

Table I: Pneumatic cylinder 's various parameters

Sr. No	Inlet Pressure	Compression Factor	M Constant
1	1	2.0	0.092
2	2	3.0	0.062
3	3	4.0	0.062
4	4	5.1	0.054
5	5	6.0	0.049

3.4 The Solenoid valve

A solenoid valve is an electromechanical device used for controlling liquid or gas flow [1]. The solenoid valve is controlled by electrical current, which is run through a coil. When the coil is energized, a magnetic field is created, causing a plunger inside the coil to move. Depending on the design of the valve, the plunger will either open or close the valve. When electrical current is removed from the coil, the valve will return to its de-energized state. In direct-acting solenoid valves, the plunger directly opens and closes an orifice inside the valve. In pilot-operated valves (also called the servo-type), the plunger opens and closes a pilot orifice. The inlet line pressure, which is led through the pilot orifice, opens and closes the valve seal. The most common solenoid valve has two ports: an inlet port and an outlet port. Advanced designs may have three or more ports. Some designs utilize a manifold-type design. Solenoid valves make automation of fluid and gas control possible. Modern solenoid valves offer fast operation, high reliability, long service life, and compact design. Also to regulate smooth movement of the pneumatic cylinder, the flow control valve have been utilized so that the burst strike could be transformed into uniform motion and as result the overall assembly could be guarded and is safe to the damages caused by the power strokes of pneumatic cylinders. The flow control valve is deployed.

Solenoid valve coils are available for both DC and AC electricity. Although a coil can be made to work with

almost any imaginable voltage, the most common voltages available are:

- 6-Volt DC
- 12-Volt DC
- 24-Volt DC
- 24-Volt AC
- 120-Volt AC
- 220/240-Volt AC

The connector standard used for solenoid valves is DIN 43650. The DIN 43650 series consists of five connectors, which have the following pin spacing:

- DIN 43650 Form A - 18 mm
- Industrial Form B - 11 mm
- DIN 43650 Form B - 10 mm
- DIN 43650 Form C - 8 mm
- Micro-Mini - 9.4 mm

The Microcontroller System

The carriage assembly shown has been interfaced with the microcontroller [3] instead of programmable logic array or programmable logic controllers in order to ensure precision and time to time amendment as per the requirement and changes. Due to interfacing with the microcontroller [3] the delay and hence the changes and the waiting time for the objects to be stacked or to be queued in becomes more flexible. The assembly language program has been burned with help of suitable IC programmer .The carriage assembly is physically connected to the pins of microcontroller I/O ports [9]. The resources of the microcontroller have been effectively. Appropriate registers have been programmed and flags are also set or cleared at optimum conditions.

The MS Comm. Port

This is a port of computer. The MS Comm control provides you with convenient access to your PC's serial ports. You can set the port number, baud rate, parity, and the number of data bits and stop bits and can open the port and send or receive data. Generally serial communication is deployed. A PC's BIOS usually allows up to four serial ports, called COM1 through COM4, even though fewer may actually be installed, and this must be morritored by the MS Communication control. In addition, there can be only one instance of any of the ports at any given time, since two programs or devices cannot use the same port at the same time. When using the MSCOMM [7] control to send and receive serial data, it is best to use event driven communications. This method is more efficient than polling, as it uses less CPU time and will only initiate an action when input is received. The entire electromechanical assembly is connected to the PC using proper and suitable interfacing technique.

IV. PARALLEL PORT AND SERIAL PORT

A Parallel interface [6] is introduced in between desktop computer and carriage assembly machine and leak test machine. As soon as scanning of bar code is complete the programmed software makes leaks test machine on by sending signal on parallel port. Also if the test is successful then a signal to make marking machine on is

sent on the different port of parallel interface. The result of leak test machine (passed or failed) is given to software via serial port [6].

V. THE DATA LOGGING

Earlier procedure of the ball bearing automation that is tracking uses a simple notebook which consists of manual entry of time of shift, employee identification, and predefined number of stake, time of work. For data logging of number of bearings available tested, number of attempts made etc for all these software is developed in Visual Basic 6.0 [4] which provides an integrated development environment. It share the systems data in terms of numeric data types. As VB.6.0 [5] is an event driven programming language. It produces result in excel sheet for a particular shift or for a date or even the employees could be assigned a login and their record can be maintained. This is convenient for the industrial application. Visual Basic 6.0 [6] provides various graphical user interface for good visualization.

VI. CONCLUSION

By the advent of this process, production efficiency can be increased to a great extent. It takes 30 second for an engine testing, and because of the use of advanced and sophisticated equipments and software reliability can be guaranteed.

The idea so far described throughout the discussion of the project aims to increase the efficiency of labor and record keeping

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