AUTOMATION OF MANUAL WORK PIECE REPLACEMENT IN CNC MACHINE USING ROBOT

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Abstract— A nowadays robot plays a vital role in industrial applications. Because of these robots, manual working by human was reduced and helps to work in hazardous area. CNC is an automatic lathe machine for production. In our project we are applying robotics in CNC machine for work piece replacement. Only work piece replacement is the manual work in CNC. So by this technique we are automating that manual work and increasing the productivity. Basically CNC works under the manual processing by humans. This manual work may time consuming, hazardous and reduce production. So to overcome this problem we are introducing robot in the place of human. Simply a pick and place robot can do this work with correct timing which we program in it. This may be a good solution to overcome the drawback of manual mistakes which increase production.

Keywords: Robot, CNC Machine.

1. Introduction

In industries, production is an important term factor which includes parts or components, joining materials and other useful products. Thus for this various component production we are using Computer Numerical Control (CNC) machine from small scale industries to larger production industries. This CNC machine can be used for various types and different models of work piece production by various machining in a single machine. So for this process humans are programming the program as per the design required and working in it only for changing the work piece.

To overcome this manual work in CNC we are going to apply robotic technology. We are introducing a multiple arm robot with pick and place technology and pressing technology in it. This will reduce the work of humans in hazardous condition and improves the productivity with good economic support. Because of robots lots of improvements were made in various fields. So we undergo this project as a latest trend of development in the society. Also we are trying to reduce the human effort in production area with correct solution to overcome that condition. This is suitable for all CNC machining industries from lower level to higher level. The alignment of CNC only changes in this project a robot in it.

I. COMPONENTS

A. CNC machine

Numerical control (NC) is a method of automatically operating a manufacturing machine based on a code letters, numbers and special characters. The numerical data required to produce a part is provided to a machine in the form of program, called part program or CNC (computer numerical control).

The program is translated into the appropriate electrical signals for input to motors that run the machine. A CNC machine is a numerical control machine with the added feature of an on board computer. The computer is referred to as the machine control unit (MCU).

(OR)

Computer Numerical Control (CNC) is one in which the functions and motions of a machine tool are controlled by means of a prepared program containing coded alphanumeric data. CNC can control the motions of the work piece or tool, the input parameters such as feed, depth of cut, speed, and the functions such as turning spindle on/off, turning coolant on/off.

A typical CNC system consists of the following six elements

- Part program
- Program input device
- Machine control unit
- Drive system
- Machine tool
- Feedback system

Types of CNC Machines

- Lathe Machine
- Milling Machine
- Drilling Machine
  - The bench drill
  - The pillar drill
- Boring Machine
- Grinding Machine

B. Robot

Industrial robots usually consist of a jointed arm (multi-linked manipulator) and an end effectors that is attached to a fixed surface. One of the most common types of end effectors is a gripper assembly. The International Organization for standardization gives a definition of a manipulating industrial robot in ISO 8373: "an automatically controlled, reprogrammable, multipurpose, manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications."

C. Robotic arm

A robotic arm is a type of mechanical arm, usually programmable, with similar functions to a human arm; the arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effectors and it is analogous to the human hand.

D. Robots in industries

An industrial robot is defined by ISO as an automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes. The field of robotics may be more practically defined as the study, design and use of robot systems for manufacturing (a top-level definition relying on the prior definition of robot).Typical applications of robots include welding, painting, assembly, pick and place (such as packaging, palletizing and SMT), product inspection, and testing; all accomplished with high endurance, speed, and precision.

Laws of Robotics by Isaac Asimov in I, Robot (1950).

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.

2. A robot must obey orders given to it by human beings, except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

In the past, factory production lines were automated for mass production, and many industrial robots and specialized machines were introduced. Recently, flexible manufacturing systems, such as the cell production system (unlike in the line production method, an entire product is assembled by one worker), are being introduced in an increasing number of production sites in order to deal with differentiation of products and to meet diversified needs. However, many of the tasks in flexible manufacturing systems rely heavily on workers because the number of parts to be handled is larger so the time and costs required to switch product types on robots and specialized machines is greater.

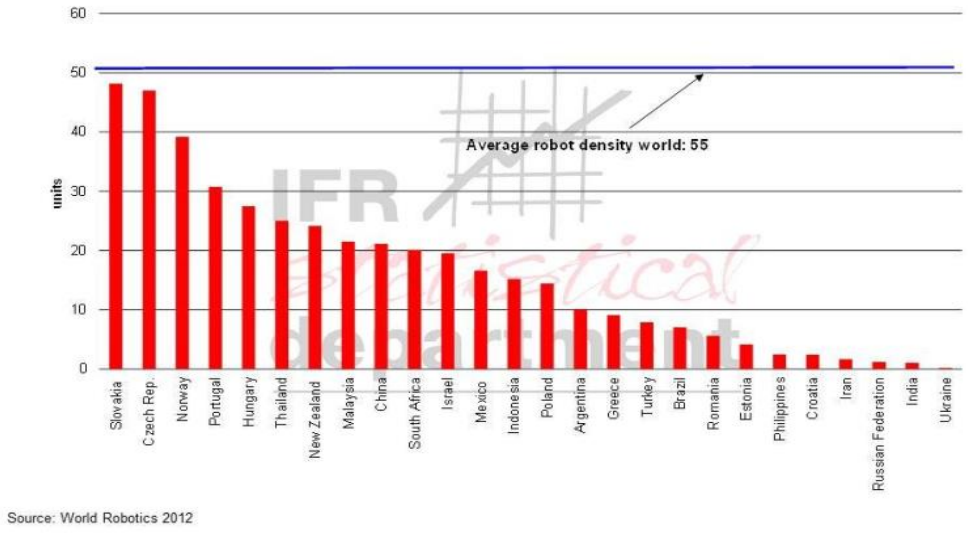

Figure 1 No of multipurpose industrial Robots per 10000 employs in the manufacturing industry

The Robotics & Mechatronics division covers very large areas. It is difficult to point out the key parameters for looking over and predicting the comprehensive technical development and discuss the future of these technologies. Thus, in this roadmap, we decided to focus on the industrial robots that have been increasing the social and technical importance. (Definition of industrial robots: automatically controlled, reprogrammable multipurpose manipulator, programmable in three or more axes, which may be either fixed in place or mobile for use in industrial applications)

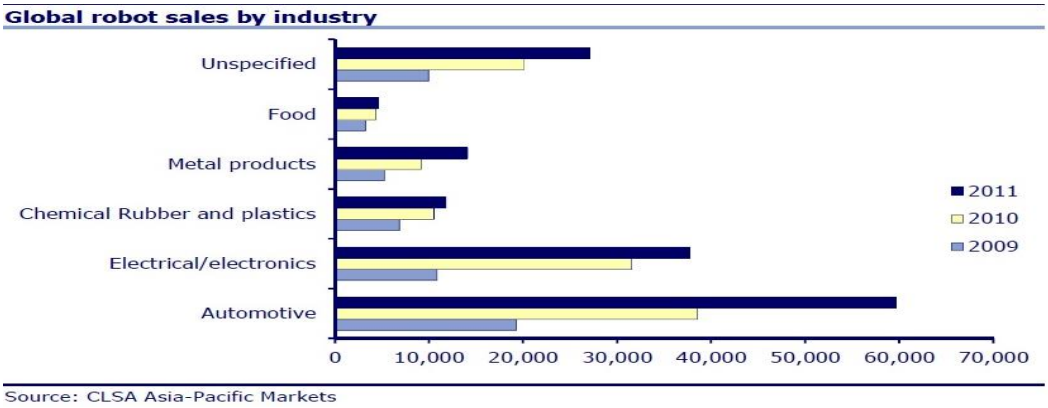

Figure 2 Global Robot Sales by Industry

E. Robot in our project

In our project we ordered the robot from a robotic centre with multiple arms. Our robot has one arm in the top and a pressing arm in the bottom. The topper arm is used to replace the work piece where as the bottom arm is to close and open the chuck for holding the work piece.

The program in the robot is programmed by the robotic centre in which the robot is purchased as per our requirement. They are very sure that they will not open the program for the customers. The maintenance and the service were made by that concern periodically.

III. CONSTRUCTION

A. CNC arrangement

As we discussed earlier a single robot is going to control four CNC machines with different time variation. So the alignment of CNC machine is an important part in this project. For aligning these machine there requires some expert to check the alignment in the floor, vibration control, level of four corners and the range of floor in which the machine is going to place. So alignment is made by the experts as a machine requires working in good condition.

B. Robot placement

After aligning the machines our robot is placed in the centre of the four machines. From that place robot do its work i.e. the replacement of work piece in the CNC machine.The upper arm in the robot is used to open the door and to replace the work piece where as the bottom arm is used to release the work piece from the chuck.

IV. WORKING

After checking all the alignments the working of our project starts. Switch on the machines and the robot which are electrically connected with the power source. The work pieces were arranged in the given arrangement which helps the robot to pick and place in the chuck. Also another arrangement is made near the machine to keep the machined material.

Working of robot,

Upper arm:

1. It opens the door of the CNC machine.
2. Removes the work piece from the chuck.
3. Keeps the machined work piece in its appropriate arrangement.
4. Pick a work piece and place it in the chuck.

Bottom arm:

1. It presses the button to release the chuck when the upper arm reaches the chuck for removing the work piece.
2. Holds the chuck when the arm reaches the chuck with the work piece which is going to machine in CNC by a press button.

Thus by this method of replacement of work piece increases the productivity.

V. ADVANTAGES

Ease of Use
- ❖ CNC machines are easier for beginners.
- ❖ Operation of several CNC machines at same time.
- ❖ Some CNC machines and robot don't need any operator; call their operator in case of the emergencies.

High Efficiency
- ❖ Operate almost continuously 24 hours a day, 365 days a year.

Expanding Options
- ❖ Expand the machine's capabilities with Software changes and updates.

No Prototyping
- ❖ New programmers provide elimination build a prototype, save time and money.

Precision
- ❖ Parts are identical to each other.

Reduce Waste
- ❖ Reduce waste as errors allows minimize wasted material.

VI. CONCLUSION

The objective for selecting this project is to overcome the difficulties in the production field. After completion of this project we are sure that the problem which is faced by the humans for work piece replacement was completely stopped. If this robots are placed in all industries the production rate was totally increased to a next level as it requires. We are satisfied by this project which helps the human in dangerous working area and save time.

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