A STUDY ON AUTOMATION AND IT'S AN INDUSTRIAL APPLICATION

RuchitaChatterjee[1], Rudrani Chatterjee[2], Dipannita Jana[3], Dipak Ranjan Jana[4]

[1,2]Asst. Prof., Dept of CSE, MIT, Purnea, Bihar

[3]B.Tech(ECE) 2nd yr., Radha Raman Institute of Tech and Science, Bhopal

[4]Principal, MIT, Purnea and Dean (BNMU), Bihar

ABSTRACT

Application of robots are being used worldwide to increase quality (high), accuracy, to increase the productivity and meet the production requirement of robot application such as computer aided design, computer aided manufacturing, computer integrated manufacturing, different application in production line, assembly line, material handling, use as service robot, military robot, agricultural application, telerobots, nanorobot, mining robot, research robot, space robot etc. Also use of robot now a day has become famous in the field of clean room, Bio-Medical, Medical, spindling, Water jet, Transaction on Automation etc. In this study a simple robot port programming for material handling in FMS using ARISTO ROBOT has been done.

Keywords: Assembly Line, Sophisticated Sensing Devices, Hazardous Material, Automated Guided Vehicles, Laser Switched Vehicles, Fahrerlose Transport System

I INTRODUCTION

Automation is the process of following a predetermined sequence of operations with little or no human labour, using specialized equipment and devices that perform the Production or Manufacturing process and control all of these. It is achieved through the use of a variety of devices such as sensors, actuators and equipment along with technique that are capable of observing the manufacturing process, decisions concerning the changes that need to be made in the operation, and controlling all aspects of it. It has evolved from the field of mechanization, which had its beginnings in the Industrial Revolution. It produces high quality of product with greater accuracy. Robot works integrates new and recondition robotic system for a wide spectrum of robot application such as arc welding, flux core welding, plasma welding, welding automation, electron beam welding, plasma cutting and tig welding. Material Handling robots applications are dispensing machine loading material handling, packaging, part transfer, press tending, injection moulding, machine trending, order picking, pick and place and vision.

Some advantages are repeatability, tighter equality control and higher efficiency, integration with business systems, increased productivity and reduction of labor. Some disadvantages are high capital requirements, decreased flexibility and increased dependence on maintenance and repair.

II OBJECTIVES

Increased productivity, Standardized Product, Reduce production time, increased manufacturing flexibility and reduces cost of production.

III TYPES OF AUTOMATION

IT, Robots, CAD, CAM, CIM, AGV, NC, FMS. The concept of automation refers to the use of computer and other automated machine for execution of related task. Automated machinery may be ranging from simple sensing devices to robots and sophisticated equipments, may be fully or semi automation.

3.1 Information Technology: <IT>

Used to create the data, store, retrieve and issue the material for production to disseminate information.

3.2 Robots

Type of automated equipment that execute different task that are normally handled by a human operator. In manufacturing, Industrial Robots are used to handle wide range task, which includes assembly, material transportation, welding, spray painting including unloading/ loading of heavy or hazardous material, inspection and testing as well as operation including process operation particularly in “online production” in Assembly line.

3.3 Computer Aided Design: <CAD>

The main functions that would utilize the computer are:

- Layout design
- Individual component modeling
- Assembly modeling
- Interference and tolerance stack checking
- Engineering drawings

3.4 Computer Aided Manufacturing: <CAM>

- Deals with different functions of production planning and control. It includes the use of NC machines, industrial robot and other automated system such as AGV for manufacturing on line production. CAM also includes CAPP, GP, and Production scheduling and manufacturing flow analysis. CAPP means the use of computer to generate process planning for the manufacturing of different products.

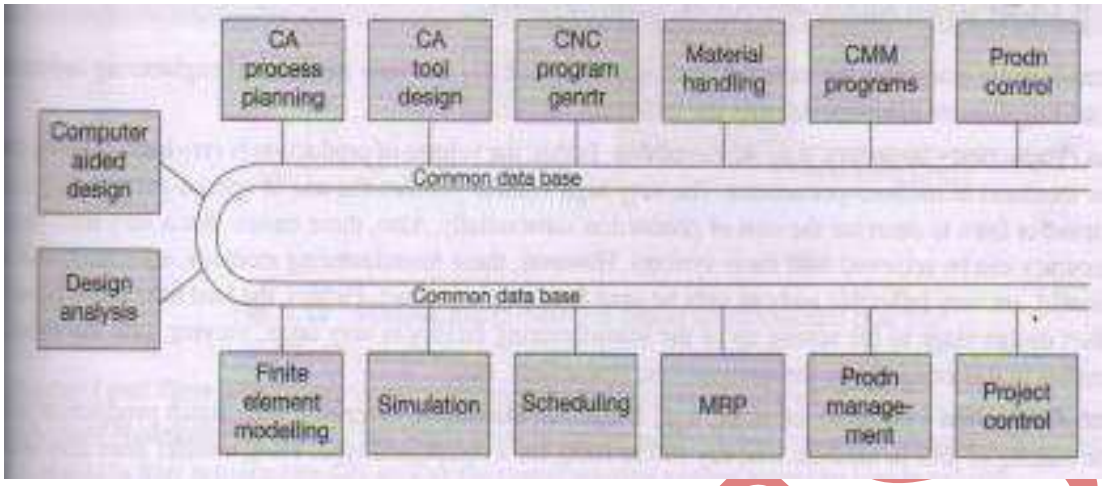

Fig 1: The common database linkage to the various computerized applications in Production Process.

3.5 Computer Integrated Manufacturing: <CIM>

Functions are linked on integrated computer network. The manufacturing related functions include PPC, shop floor control, CAD, CAM, purchasing, marketing functions. The objective of CIM is to allow changes in production design, to reduce cost and optimize production requirement. CAD & CCAM are the overall production system into CIM. The features are flexibility in design and manufacturing through software support. CAD does the design with calculating features like strength, stiffness and weight. Computer Graphics enables the design to study the object by rotating of the components on the screen, separating it into segments, enlarging specific portion of the components to be observed in detail. CAM means the use of a computer to assist in manufacturing of part. In CNC, automatic control system of foils and robot control and applications such as preparation of programming on punch tape. CAM technology is mainly concerned with three areas like NC, Process Planning and Robotics with the aspect of Planning, Managing, Monitoring and controlling all phases.

3,6 Automated Guided Vehicles: <AGV>

Automated guided vehicles (AGVs) increase efficiency and reduce costs by helping to automate a manufacturing facility or warehouse. The AGV can tow objects behind them in trailers to which they can autonomously attach. The trailers can be used to move raw materials or finished product. The AGV can also store objects on a bed. The objects can be placed on a set of motorized rollers (conveyor) and then pushed off by reversing them. AGVs are employed in nearly every industry, including, pulp, paper, metals, newspaper, and general manufacturing. Transporting materials such as food, linen or medicine in hospitals is also done. An AGV can also be called a laser guided vehicle (LGV). In Germany the technology is also called Fahrerlose Transport system (FTS). Lower cost versions of AGVs are often called Automated Guided Carts (AGCs) and are usually guided by magnetic tape. AGCs are available in a variety of models and can be used to move products on an assembly line, transport goods throughout a plant or warehouse, and deliver loads.

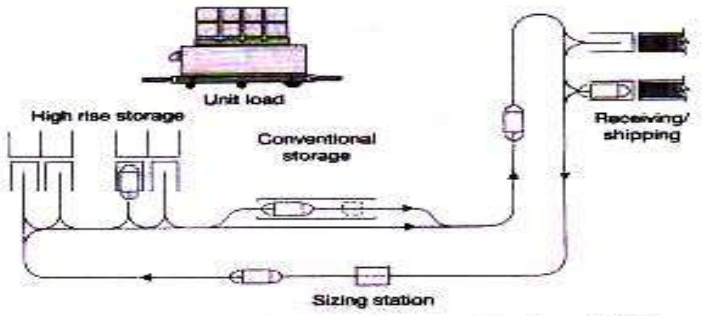

Fig 2: Typical application path of a unit load type AGVS

3.7 Numerical Control: <NC>

NC machines tools that execute operations in sequence or part of a product. Individual machines have their own computers for that purpose; such tools are commonly referred to as computerized memory controlled machines. In other case, many machines may share the same the computer; they are called direct NC machines.

The utilization of NC in manufacturing follows steps to be considered:

- Process planning
- Part programming
- Tape preparation
- Tape verification
- Production process

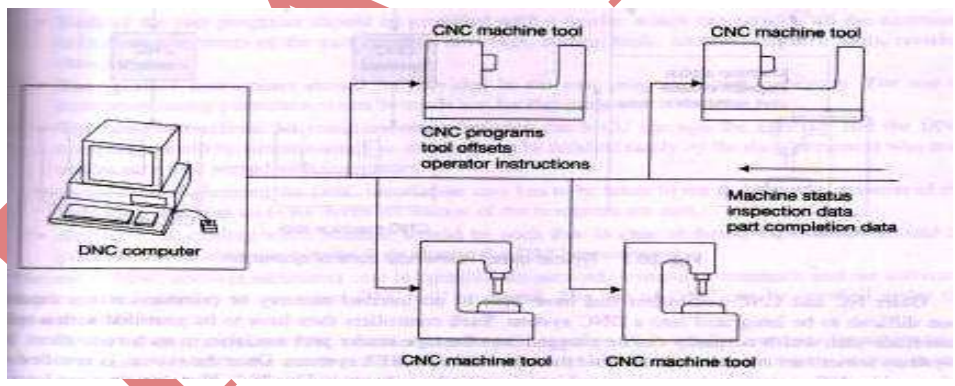

Fig 3: Typical direct numeric control operation with enhanced functions

IV ROBOT AND ITS TYPES

4.1 Industrial Robot

Industrial robot is an automatic position controlled reprogrammable, malfunction manipulator having several degrees of freedom capable of handling materials, parts and tools or specialized devices through variable programmed motions for the performance of a variety of tasks.

4.2 Agricultural Robot

They are being used for repetitive farm tasks such as harvesting, plowing fields and even planting seed.

4.3 Mobile Robot

They are referred to as autonomous or self guided vehicles and are taught to navigate the space they are required to work around or in.

4.4 Telerobots

They are used to conduct tasks in environments that are too hazardous for humans to work in.

4.5 Service Robots

The Japanese were the first to invest heavily in the development and commercial deployment of service robots. Robots are now used for far more than industrial applications.

4.6 Nanorobots

It is an extremely small robot that operates on microscopic scale with sizes ranging from 0.01 to 0.1 micrometers. Currently most nanorobot research is being done in the medical and military fields.

4.7 Military Robots

Possibly the worst part of robotic application is in military use, as it may curtail human life instead of upholding it.

4.8 Mining Robots

They are designed to help counteract a number of challenges currently facing the mining industry.

4.9 Research Robots

Focuses not only the specific industrial tasks, but on investigations into new types of robot, alternative ways to think about or design robots, and new ways to manufacture them.

4.10 Robots On Earth

- **Cartesian robot / Gantry robot:** Used for pick and place work, application of sealant, assembly operations, handling machine tools and arc welding.
- **Cylindrical robot:** Used for assembly operations, spot welding and handling at die-casting machines.

- **Spherical / Polar robot:** Used for handling at machine tools, fettling machines, gas welding and arc welding.
- **SCARA robot:** It is a robot which has two parallel rotary joints to provide compliance in a plane.
- **Articulate robot:** Used for assembly operations, spray painting, gas welding, arc welding and handling at die-casting machines.

V ROBOTS IN SPACE

Space based robotic technology at NASA falls within three specific mission areas: exploration robotics, science payload maintenance and on orbit servicing. Today, two important devices exist which are proven space robots. One is the Remotely Operated Vehicle (ROV) and the other is the Remote Manipulator System (RMS).

5.1 Use Of Industrial Robot For "Online" Production Process

This system is a totally free service and tailored to allow differing degrees of access and interaction. The main benefits and functions of the service are:

a) Automatic notifications by email at the main stages of production as follows:

- Order creation
- Receipt of goods
- Receipt of artwork and/or where necessary artwork amendments and associated charges
- Paper proofing amendment and/or approval
- Pre- production sample dispatch, amendment and/or approval
- Completion of production or order cancellation
- Order dispatch
- Automated Assembly

b) Direct customer and/or consumer interaction for things like amendment instructions and/or approvals: This significantly decreases Administration and massively speeds up the production process. It also removes errors of communication common with other forms of communication.

c) Order tracking: During production our customers and the consumers can log in at any time to track the order status as it progresses through our production system. This facility is available 24/7 making it the fastest, most convenient way to find out information and the status of a job.

d) Increased efficiency and lower costs: The resulting increase with efficiency allows us to minimize costs and so keep our prices lower.

e) Delay notifications: If there is a delay of any sort the system automatically generates a warning email to advise all parties. This occurs on a daily basis.

f) Future features: Future features of the system will allow for even greater levels of interaction, such as customer/consumer amendment of the delivery address and delivery method.

VI FLEXIBLE MANUFACTURING SYSTEM: <FMS>

Emphasis core machine tools are the comprehensive system, robots and automated material hand system on the manufacture of similar product or computer using different routing among the machines. FMS supplies with plurality a set of NC machine part programming. If programmed form a supervisory control computer system transporter, each moving under the control of material handling system.

VII SIMPLE ROBOT PARTPROGRAMMING FOR MATERIA HANDLING <PICK & PLACE> IN FMS USING ARISTO ROBOT

7.1 Objectives

- To learn joint movements.
- To learn format a program for PTP operation or ARISTO Robot software.
- To write a program & make simulation.
- To study co- ordinate system: where some major co- ordinate system based on which robots are generally specified.

The common design of Robot co- ordinate systems are:

- Cartesian co-ordinate system
- Cylindrical co-ordinate system
- Polar or Spherical co-ordinate system

7.2 Co-Ordinate Of Aristo Robot

After giving the values in the appropriate axis box, we can see the changes in the respective axis in the coordinate position (WCS). Let no see in detail, all the coordinate used in MATLAB ARISTO ROBOT.

7.3 World Co-Ordinate System

Three co-ordinates x, y, z are arranged at right angled as shown in the figure. The co-ordinate system is situated at the centre point at the base. Co-ordinate axes are measured in mm & the positive direction are indicated in the figure by arrow tips with the help of this system. We consider the actual location of Robot.

7.4 To Learn Joint Movements

The joint movement, the joint axis (for i) is established at the connection of two links. This joint axis will have two normal's connected to it , for each of the links w.r.t. relative position of two such connected links (link –i, -1 & i)is given by di which is the distance measured in a plane normal to the joint axis. Hence di and Φi may be called the distance & the angle between the adjacent links respectively. They determine the relative position of neighboring links.

BASE	JOINT 1	(+) (-)
ROLL	JOINT 6	(+) (-)
ELBOW	JOINT 3	(+) (-)
PITCH	JOINT 4	(+) (-)
SHOULDER	JOINT 2	(+) (-)
WRIST	JOINT 4	(+) (-)

7.5 To Learn Format A Program For Ptp Operation - Aristo Robot Software

- To learn Robot commands.
- Format of program for joint command.

This command is capable of moving the axis one by one. The angular values are provided to it as the parameters for the operation. The individual axis terminates this movement one by one.

7.6 Format for Ptp Operation

This command is capable of moving the entire axis simultaneously. The co-ordinate values are provided to it as the parameters for the operation. All the axes terminate their movement simultaneously.

7.7 Writing The Program And Making Simulation

SPEED 50
JOINT A_1 90.15, A_2 90.00, A3 90.00, A_4 0.00, A_5 90.00, A_6 0.01
GRIPPER OPEN
JOINT A_1 49.23, A_2 89.47, A3 89.71, A_4 0.00, A_5 90.00, A_6 0.01
JOINT A_1 49.23, A_2 -45.52, A3 45.77, A_4 0.00, A_5 90.00, A_6 0.01
JOINT A_1 49.23, A_2 -45.52, A3 45.77, A_4 0.00, A_5 -7.67, A_6 0.01
JOINT A_1 49.23, A_2 -45.52, A3 67.82, A_4 0.00, A_5 -23.26, A_6 0.01
JOINT A_1 37.75, A_2 -45.52, A3 67.82, A_4 0.00, A_5 -23.26, A_6 0.01

ATP X +473.67 Y +382.282 Z +229.54 W 38.41 P 84.04 R 0.66
ATP X +473.52 Y +382.17 Z +213.88 W 85.54 P 89.09 R -0.79

GRIPPER CLOSE
PTP X +493.05 Y +381.86 Z +255.46 W 38.42 P 88.93 R 0.67
JOINT A_1 37.75, A_2 -71.29, A3 80.74, A_4 0.00, A_5 -20.38, A_6 0.01
JOINT A_1 -47.54, A_2 -71.29, A3 80.94, A_4 0.00, A_5 -20.37, A_6 0.01
JOINT A_1 -47.54, A_2 -97.29, A3 85.62, A_4 0.00, A_5 -20.38, A_6 0.01

PTP X +355.48 Y -388.49 Z +355.25 W -47.42 P 83.94 R 0.1L
PTP X +356.46 Y -389.57 Z +324.23 W -47.42 P 84.27 R 0.1L

GRIPPER OPEN
JOINT A_1 90.15 A_2 -90.00 A_3 90.00 A_4 0.00 A_5 90.00 A_6 0.01

VIII CONCLUSIONS

Implementation of Industrial robot in semi or fully automation deals with the optimization of energy efficient drive systems by précised measurement and control technologies so energy efficiency in Industrial process are becoming more relevant. Use of automation refers to automation like desktop automation and automated voice solution makes easier to work across multiple desktop tool where automated voice solution allow the agent to remain on the line while disclosures and the other important information is provided to customers in the form of pre- recorded audio files so utilization of the robots plays in minimization of the costs in production with greater accuracy of product.

REFERENCES

1. ^ Rifkin, Jeremy (1995), *The End of Work: The Decline of the Global Labor Force and the Dawn of the Post Market Era*, Putnam Publishing Group. pp 66, 75. ISBN 0- 87477-779-8
2. ^ Bennet 1993, pp. 7
3. ^ [a b c] Bennet 1979
4. ^ Bennet 1993, pp.31
5. ^ Rifkin 1995
6. ^The American Society of Mechanical Engineers Designates the Owens "AR" Bottle Machine as an International Historic Engineering Landmark " (http:// files. Asme.org/ ASMEORG/ Communities/ History/Landmark/5612.pdf). 1983
7. ^ Landes, David. S. (1969). The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present. Cambridge, New York: Press Syndicate of the University of Cambridge. P. 475.
8. ^ Process automation, retrieved on 20.02.2010 (http:// www.bma –automation.com)
9. ^Stationary Engineers and Boiler operators (http:// www. Bls.gov/oco/ocos228.htm)
10. ^ Bennet, S. (1979). A History of control Engineering 1800-1930. London: Peter Peregrinuss Ltd.pp.47, 266. ISBN 0-86341-047-2
11. ^ Jerome, Harry (1934). Mechanization in Industry, National Bureau of Economic Research (http://www.nber.org/chapters/c5238.pdf).p. 158
12. ^Bennet 1993, pp. 65Note 1
13. ^ Wheelie: Toshiba's new robot is cute, autonomous and may be even useful (video)(http:// techcrunch.com/2010/03/12/wheelie- Toshibas-new-robot- is –cute-autonomous- and- maybe- even- useful-video/)
14. ^ Javed, O, Shah, M. (2008). Automated multi camera surveillance. City of publication: Springer- Verlag New York Inc.
15. ^ Menzies, Thomas. R. National Automated Highway System Research Program A review. 253. Washington D.C.: Transportation Research Board, 1998. 2-50.

ACKNOWLEDGEMENT

With deep sense of gratitude, I express my sincere thanks to my esteemed and worthy guide Prof.(Dr.) Dipak Ranjan Jana, Principal, Millia Institute of Technology, Purnea & Dean, BNMU, Madhepura, Bihar for his valuable advice, motivation, guidance, encouragement, efforts, facilities, timely help and the positive attitude with which he solved all of my queries in making this paper possible. It has been a great honour for me to work under him. I am also thankful to the authors whose work I have consulted and quoted in my work.

Ruchita Chatterjee: B.Tech. (CSE), M.Tech.(ECE), Ph.D.(Scholar) Dept. of ECE, MIT, Purnea, Bihar, India

Rudrani Chatterjee: B.Tech. (ECE), M.Tech.(ECE), Ph.D.(Scholar) Dept. of ECE, MIT, Purnea, Bihar, India

Dipannita Jana: Student (ECE) 2nd yr., Radha Raman Institute of Tech and Science, Bhopal, India

Prof. (Dr.) Dipak Ranjan Jana, Principal (MIT, Purnea), & Dean, (Faculty of Engineering) BNMU, Madhepura, Bihar, India