Research Article

Productivity Enhancement of Robot by Man-machine Study

Narawade Avinash R†*, Chandankar Bhagyashri G†, Chapte Viresh M! and Chavan Sachin V†

†Marathwada Mitra Mandal Institute of Technology, SPPU, Pune 47, India
!Dr. DYPSOET , SPPU, Pune ,India

Abstract

The man machine study is often used to exemplify the most productive way to use multiple operators, machines or any combination of people and machines. Man-machine time study is used to minimize idle operator/machine time, to optimize resources of operator and machines so that all the possible resources can utilized. The OEE also allows for drilling down for very specific analysis, such as a particular Part Number, Shift, or any of several other parameters. It is unlikely that any manufacturing process can run at 100% OEE. Many manufacturers benchmark their industry to set a challenging target; 85% is not uncommon.

Keywords: Teach pendant, Controller, SAP, Idle Time.

1. Introduction

Teaching pendant is a handheld device by which a human can control a robot. The main functions of a teaching pendant are moving the robot, teaching it about the locations, running robot programs, and jogging the axes. In practical industrial applications, today there are two main categories of robotic programming methods, which are, online programming (including lead-through and walk-through) and offline programming (OLP). Online programming has been carried out by skilled robot operators by guiding the robot through the desired path using a teach pendant, namely the lead-through method. Typically, the lead-through method includes the steps of jogging the robot through the desired path, recording the specific points in robot controller, and utilizing the recorded points to create movement commands, (Robert J. Schilling, 2002).

The robot operator programming a robot using a lead-through method is responsible for guiding the robot and maintaining the desired position and orientation of the robot in six degree-of-freedoms (DOFs). The Type of programming used in our project is LEADTHROUGH METHOD of programming.

2. Robot Programming

The Type of programming used in our project is LEADTHROUGH METHOD of programming .In Lead through method of programming, the robot is moved through the desired motion path in order to record the path into controller memory. There are two ways of accomplishing lead though programming

1. Powered Lead through
2. Manual Lead through

Our model i.e.DR4000 uses Powered lead through method of programming. This method makes use of a teach pendant to control the various joint motors and to power drive the robot arm and wrist through a series of points in space. Each point is recorded into memory for subsequent playback during the work cycle.

3. Teach Pendant

Teaching pendant is a handheld device by which a human can control a robot. The main functions of a teaching pendant are moving the robot, teaching it about the locations, running robot programs, and jogging the axes. A teaching pendant is usually connected to the robot by a cable. The cable connection and the size of the teaching pendant generally do not pose a problem when the robot controller is separate from the robot. It can perform basic operations such as executing robot program designating robot locations, halting the robot in an emergency, and jogging each axis.

3.1 Advantages

1. Online programming is a completely manual process.
2. The robot operator has the freedom to move the robot, select the configuration and plan the process.

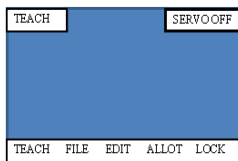3. It is an efficient and cost effective solution for a simple robotic system**.**

Fig.1 Teach Pendant Display

3.2 Programming Command

One of the most important tasks is programming the robot, which is considered very difficult to evaluate because each brand has its own robot programming code. Even in well-defined and structured environments such as in the automotive industry robot reprogramming is still necessary in order to cope with uncertainties. Table shows various Robot programming commands**.**

Program no-001(1900 N)

Table 1 Programming Commands

Line no	Points	Speed	
001	P	100%	BASE M1
002	P	100%	BASE M1
003	P	100%	BASE M1
004	P	100%	BASE M1
005	P	100%	BASE M1
006	P	100%	BASE M1

AS 110A, 16.2V, 55cm
007 *L 100cm   BASE M1
AE 100A, 15.0V, 0.05, 0.05
011   END

After studying Robot Programming by implementing shortest possible path, cycle time is changed.

4. Cycle time

After implementing new simplified programming cycle time is reduced by 22 %. Then total parts produced for 15 days in 8 hrs shift are increased to 8632 and the performance rate is near to 94.12 %.

Table 2 Cycle time table

008	P	100%	BASE M1
009	P	100%	BASE M1
010	P	100%	BASE M1

Aspects	Bonnet Lock Plate (370N)	Wind Shield (1900N)
Total Time (Home-Welding-Home)	32 sec	58sec
Welding Time	33 sec	61.2 sec
Part loading/Unloading	36sec	50sec

5. Man-Machine Study

Man-machine chart graphically represents the relationship between the manual work performed by one or more operators A and one or more machines involved in a manufacturing process. The different work steps required in a production process to load, operate and unload machines in conjunction with the process times of the machines themselves the man-machine chart is used to determine the highest production level that can be achieved given the resources available. This process usually involves performing as much manual work as possible internal to the machine cycles i.e. when the machine is running so that when the machine cycle is complete the production generating machine cycle can be restarted again with as little downtime as possible.

Table 3 Study time table

Sr. No	Category	Start	End	Engage Time	Idle time
1	Robot	0	79	79	11
2	Operator-1	0	24	24	6
3	Operator-1	37	88	51	7

6. SAP

SAP means "System Analysis and Program Development" software. SAP is very helpful software which carries all the information online and so the paper work is reduced which gives rise to fast production and increase in overall efficiency. The down time analysis in SAP is done by using command *zrrOEE.* The controlling of any machine by hourly monitoring system is one of the applications of SAP.

7. Time Study

Man-machine chart, normally generated during labor time study, is a chart of the coordinated synchronous or simultaneous activities of a work system of one or more workers. Table 4 shows time study of man machine. Each machine or operator is shown in a separate, parallel column indicating their activities with relative to the rest of the work system.

Table 4 Time Study Table

Work station		Robot	
Part		Wind shield	Lock plate
No of Heads require		1	
Total cycle time(sec)		90	
Robot	Engage time	79	
	Idle time	11	
Operator 1	Engage time	75	
	Idle time	15	

The data is often used to exemplify the most productive way to use multiple operators, machines or any combination of people and machines. It points out activity time, idle time and cycle time of operator and machine.

8. Cycle time chart

Robot is idle for 8 sec per cycle. So check feasibility to produce another part within 8 sec means find one part which having welding time of 7 sec. That improves OEE of Robot. Material handling is more from trolly to robot. So, material to be kept nearer to robot which will save daily 1.5 hrs for material handling.
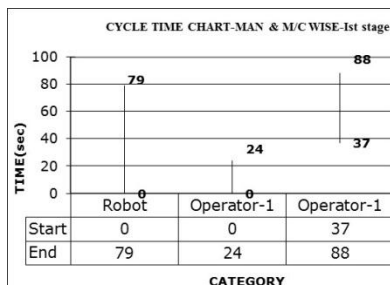

Fig .2 Cycle time chart

9. Results

The increase in availability rate results improvement in production. The welding torch following minimum possible travel shows reduction in cycle time of robot. The last chapter is discussed about Overall Equipment Effectiveness (OEE), which is also improved. The cycle time of robot is also reduced. It means increase in parts per hour production is possible.

Conclusions

The man machine study is often used to exemplify the most productive way to use multiple operators, machines or any combination of people and machines. Man-machine time study is used to minimize idle operator/machine time, to optimize resources of operator and machines so that all the possible resources can utilized.

References

Mikell P.Groover, Mitchell Weiss, Roger N.Nagel, Nicholas G.Ordrey, (1986), Industrial Robotics-Technology, *Mcgraw-Hill Publication* .

Robert J.Schilling (2002),Programming and Application, *McGraw Hill Book Company* .

Ganesh S. Hegde(2006),Fundamentals of Robotics Analysis and Control, *Prentice-Hall of India Pvt.Ltd, New Delhi.*

Ganesh S. Hegde, (2008),A textbook on Industrial Robotics, *University Science Press* .

Berhard Hodges, (1993),Industrial Robotics-2e, *Jaico Publishing House* .

Instruction Manual for Model DR Series, (2001),Installation and Maintenance, *Daihen corporation.*