Potential manufacturing productivity changes arising from the application of Internet-based technologies

W.C. Kwong [a,*], Dario Toncich [b], S.F. Lee [a]

[a] *Department of Industrial Engineering and Management, Hong Kong Institute of Vocational Education,
B324, L3, 20 Tsing Yi Road, Hong Kong, PR China*
[b] *Industrial Research Institute Swinburne (IRIS), Swinburne University of Technology, Australia*

Abstract

This paper describes a series of industry-based projects involving simulation, scheduling and monitoring of the facilities in a distributed environment based on World Wide Web (WWW) technologies so that its operations located in geographically distant regions can be integrated. The recent WWW technologies would enable operations such as scheduling, simulation as well as the monitoring of a flexible manufacturing system (FMS) through the Internet to be achieved. In the School of Manufacturing Engineering of Nanjing University of Science and Technology (NUST) in China, a manufacturing environment simulating the operations of a FMS has been created to provide a unique show-window for academics as well as industry through Internet. The users in NUST can use the web browser to access the server in Hong Kong and run the applets to schedule, simulate and monitor the FMS in Hong Kong. After building the server system with the necessary web server, video server and the applets linking to the machines of the FMS, the effect of changes in productivity will be studied.
© 2003 Elsevier Science B.V. All rights reserved.

Keywords: World Wide Web Internet; Flexible manufacturing system; JAVA; Applets

1. Introduction

The objective of a series of industry-based projects involving simulation, scheduling and monitoring of the facilities [1,2] in a distributed environment based on World Wide Web (WWW) technologies is to study the effect on changes on the productivity. Firstly, a customer training centre has been built in Nanjing, China. This centre can provide the users in Nanjing the access to the operation, simulation as well as the monitoring of the CNC machines and robots in the flexible manufacturing system (FMS), located in Hong Kong. The basic feature of a FMS has to be introduced in order that the users in Nanjing can understand the operation of the FMS. The FMS in Hong Kong consists of two CNC turning centres with a handling robot and one horizontal and one vertical CNC machining centre. An automatic guided vehicle (AGV) is used to transport the parts between an automatic store retrieval system (ASRS) and the CNC machines. An articulated robot is employed to serve the two turning centres. The layout of the FMS in Hong Kong is shown in Fig. 1.

In Section 2, the Internet server application including WEB pages design, database connectivity, user login procedure, file upload and download, video/audio streaming, and protocol for drawing data or NC program transfer to keep data integrity, is developed [3]. This server enables users in Nanjing to connect to Hong Kong through the Internet and give commands to the controller of the basic components of the FMS and to see the operation of the real CNC machines, and robots as well as the whole FMS in Hong Kong through the on-line video server. The video server is presented in Section 3.

In Section 4, the monitoring and operation of a robot or CNC machine at different locations through the Internet are developed and tested with different situations [4]. A SCORBOT articulated robot in Hong Kong is connected to the Internet and its advanced terminal software (ATS) provides a user interface for controlling the robot. This user interface program can be shared by another user at a different location who is also connected to the Internet. In order to operate the robot, the remote user has to monitor the operation of the robot through the on-line video display. This arrangement help the user in Nanjing to understand the operation of a robot. Safety is an important factor in the remote operation and monitoring of a robot.

In Section 5, the sharing of the CAD/CAM software over the Internet is presented. The modelling of the FMS and its

* Corresponding author. Tel.: +852-243-68704; fax: +852-243-45695.
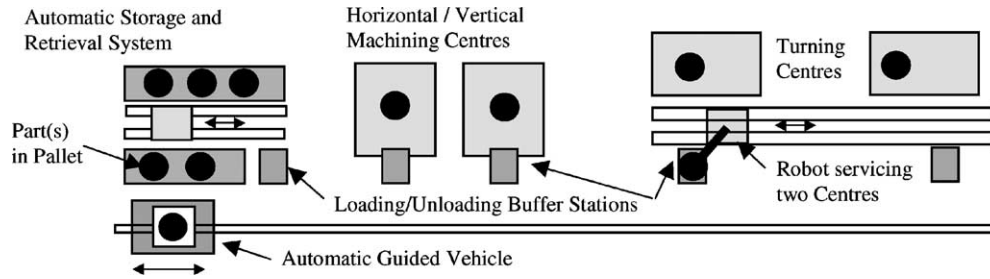*E-mail address:* wckwong@vtc.edu.hk (W.C. Kwong).

Fig. 1. Layout of the FMS in the Hong Kong Institute of Vocational Education (Tsing Yi).

scheduling and simulation through the web browser [5] is discussed in Section 6. A brief summary of the series of the industry-based projects is given in Section 7.

2. Internet servers

The Internet server in Fig. 2(a) is located in the HK Institute of Vocational Education (Tsing Yi). It consists of one server grade PC and one video server. Both servers connect to a router and reach the Internet through the leased line. WINDOWS NT and IIS4 are run in the server. The Web server and FTP server are located in the Internet server. The Web page and related application software are developed and stored in the Web server. The video server is a dedicated device which provides multiple inputs for the video signal and signal compression function. It is connected to the router directly.

The purpose of the Web server, as shown in Fig. 2(b), is to expose the Web page to the users connected to the Internet, and receive commands from authorized users [6]. The FTP server is pointed to the directory for storage of drawing data and NC programs and opened for users to upload and download files.

3. Video server

The video server provides the real time monitoring from several locations of the FMS system with pan, tilt, and zoom functions at the cameras. The user in Nanjing can access the video server through the web browser by http://IP address/. The web page will display the graphical user interface on the left-hand side as in Fig. 3. The control of the cameras together with its pan/tilt/zoom functions can be activated with the JavaScripts. This simple script runs within the browser with the script source being part of the Hyper Text Markup Language (HTML) files. This script consists of the selection of the camera which can be expanded up a maximum of six cameras displaying the various parts of the FMS simultaneously. The control sensitivity can be selected for better control of the tilt/pan/zoom of the cameras.

The applets are retrieved from the Internet server and run to provide the user menu as shown on the top of the view in Fig. 3. The applets can also get the video display of each camera as selected by the users through the web browser. The display of the camera 1 is the live demo of a part of the FMS in Hong Kong.
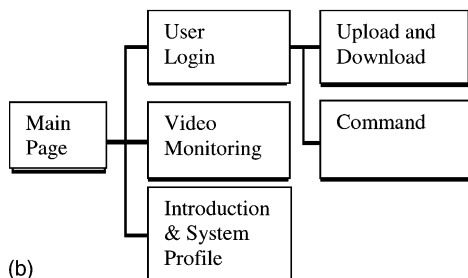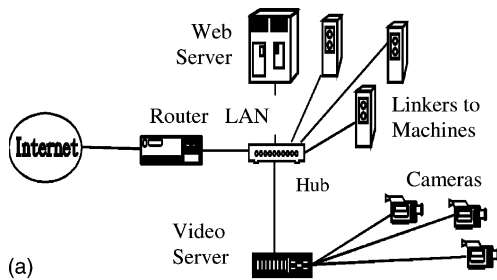

Fig. 2. (a) Architecture of the Internet Server. (b) Web page chart.

Fig. 3. Live demo for the video display of the FMS.