ROBOT E_LABORATORY

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Abstract: This paper presents a virtual laboratory accessible through the Internet. The objective of Virtual Laboratory is to provide remote access to robots infrastructure and programming. Virtual Laboratory has been implemented as a new generation communication service, not as a common World Wide Web (WWW) application. So, it employs a sophisticated access framework, a communication infrastructure able to support multimedia flows, and a component-based software construction. The architecture of a Virtual Laboratory relies on open standards, such as WWW and its related technologies (HTTP, HTML, Java, Macromedia Flash, PHP, MySql ...).
Practical experience is an important component of education. The time and money required for the panning and construction of scientific laboratories is outside the scope of many instructions. In this context, education and engineering scholars have proposed the creation of research and development of virtual laboratories to allow users to perform experiments from a remote location. Users can plan and conduct experiments, collect experimental data, and analyze the results as if they were physically present in the laboratory.

Key words: e-learning, robotics, tutorials, textbooks, exercises

1.INTRODUCTION

Virtual laboratories are an important educational tool that bring together geographically distant research groups, allowing them to share data, documents, video, while integrating their computational and laboratory resources. Among the many benefits of virtual laboratories, the following are particularly important.

1) Resource sharing becomes a reality, improving the utilization of costly equipment.

2) Easier access to educational and research material is provided to students and professionals.

3) Scientific investigation standard can be established in areas where practical experimentation is a required part of research.

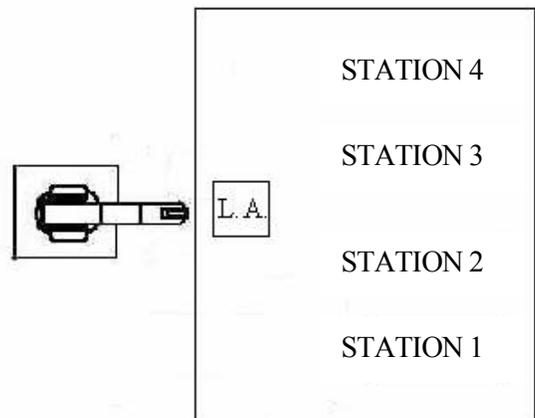4) Reduction in travel time leads to productivity enhancement.

Fig 1.1

2.APPLICATION ENVIRONMENT

We wanted to design a manipulator to attendance the IRB 1400 robot in different operations it can execute. In principle, it has the role of extracting from the buffers parallelepiped and cylinder pieces (pins).

It must be well known the fact that whole range of actuator elements, distribution and detection are SMC™ brand.

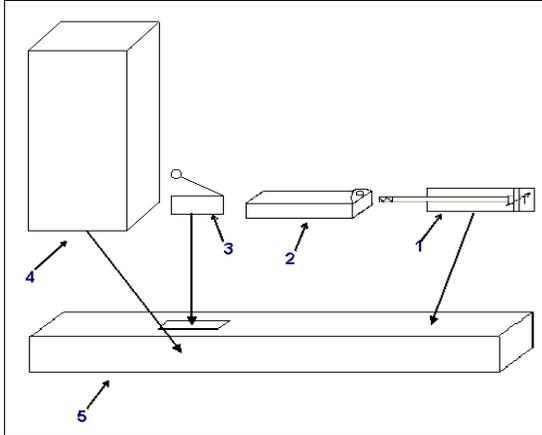The parallelepipeds extracting stations have the following structure:

Fig 2.1

Parallelepiped Extractor
1. pneumatic pistons;
2. pusher;
3. piece holder;
4. micro-contact who detects the presence of the piece;
5. stand used by the pusher.

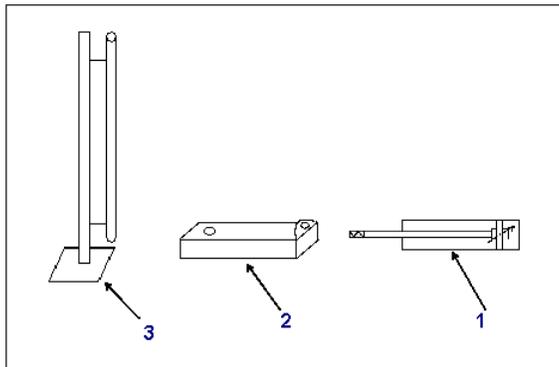The pin extracting station structure is the following:

Fig 2.2

Pin extractor
1.   pneumatic piston;
2.   pin carrier;
3.   piece holder.

To grab both parallelepiped and pin pieces, the robot gripper was modified, resulting the following shape:
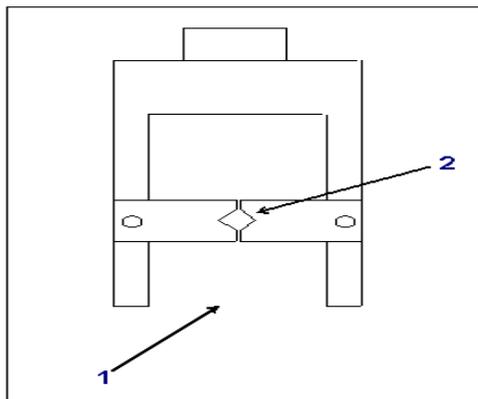

Fig 2.3

1) parallelepiped grab area
2) pin grab area

His actuation is made by an double effect pneumatic piston, the air being distributed by a 5/2 electro-valve with automated pilot and separated discharges. Gripper pneumatic diagram is as shown:
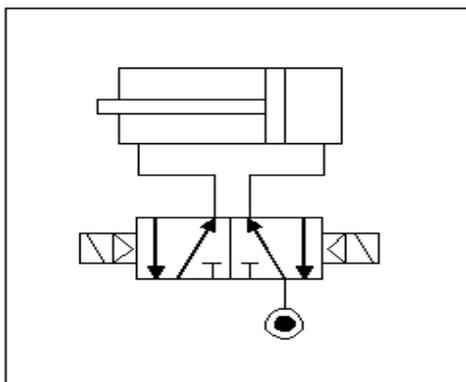

Fig 2.4

Robot interconnection with the manipulator is made by controller input/output port. His indicator is DSQC 327, being digital inputs/outputs. There are two slots of 8 inputs each and two slots of 8 outputs. The power needed to function in the I/O ports logic is a source of 24V cc.

S1, S2, S3, S4, S5, S6, S7 and S8 symbolize the sensors placed on the four pneumatic pistons on their stroke ends. So, it is well known their position (advanced/retreated). This feature is important in manipulator cycle management.

The site is organized as follows:

3.Site description

Section "**Home**":

Registration:

User account is useful for access entire information area and use Virtual Program Maker for storing work data for each logged user. If he is not registered it is possible to register through completing a registering form available from home page clicking "new user".

"Site description" **described object at this VRC, menu description and information about textbox, tutorials and exercise.**

"Consulting" –user have possibility to send a question in administrator mail.

"Forum" –the object at this forum is to interchange information between users .For creating a topic user must have an account in home page The forum have an administrator account for controlling dialog and topics between users.

"Site map" –content a map with menu links.

"Picture gallery"- content picture with laboratory and application.

"Authors"- content authors at this site and possibility to contact them.

Section **"Programming"**

-**"RAPID Summary"**

This chapter briefly describes all instructions, functions and data types grouped in accordance with the instruction pick-lists using when programming. It also includes a summary of the syntax, which is particularly useful when programming off-line. **RAPID Summary** content:

-**"Communication Interface"**

This chapter describes equipment, which the robots can communicate with computer, or other equipment via RS232/RS422 serial channels or via Ethernet.

-**"Communication protocol"**

This chapter shows the protocols use in the S4 Controller. All protocols except the Robot Application Protocol (RAP) are standard protocols: SLIP, Ethernet, IP, ICMP, TCP, UDP, RPC/XDR, TFTP, Bootp, RAP, NFS, FTP.

-**"Program Maker description"**

-**"Instruction Set"**

Present instruction details for programming ABB robots

-**"Operator interface"**

This chapter describes how to programming a robots using Teach Pendant and offered possibility to test a Virtual Teach Pendant.

- **"Sample"**

This chapter describes sample with robots programming including useful instruction for a better understanding of working laboratories. This chapter contend sample at Motion application, cylindrical pieces palletizing, Paralelipedicall pieces palletizing, assembling pieces, Welding operation. This textbox content program source and simulated and interactivity application for a better understanding.

Section "**Tutorials**" content

Motion application

Purpose of work laboratory

Programming for the robot to do a simple motion application to write its own name. (ABB IRB 1400).

User can see a simulated application and sample code.

Cylindrical piece palletizing

Purpose of work laboratory

Realizing of program for pin palletizing operation with ABB Robot IRB 1400.

We have pin pieces of two types: a pin pieces have big holes pierced and other small holes pierced. Flowing of the cylindrical pieces is supplied by the workstation number three and workstation number four. All the pieces must be placed in a matrcial storehouse with eight locations. User can see a simulated and interactivity application and sample code.

Paralelipipedical pieces palletizing

Purpose of working laboratory

Realizing of program for paralelipipedical pieces palletizing operation with ABB Robot IRB1400.

We have paralelipipedical pieces of two types: one of these types has three holes pierced and the other type of these pieces has three holes pierced. All the pieces must be placed in a matrcial storehouse with four locations.

User can see a simulated and interactivity application and sample code.

Assembling pieces

Purpose of work laboratory

Realizing of program for assembling operation with ABB Robot IRB1400.

Inputs and outputs used for this operation:

We have paralelipipedical pieces of two types: one of these types has three holes pierced and the other type of these pieces has three holes pierced. Assembling of these two types of pieces we will obtain a new product.
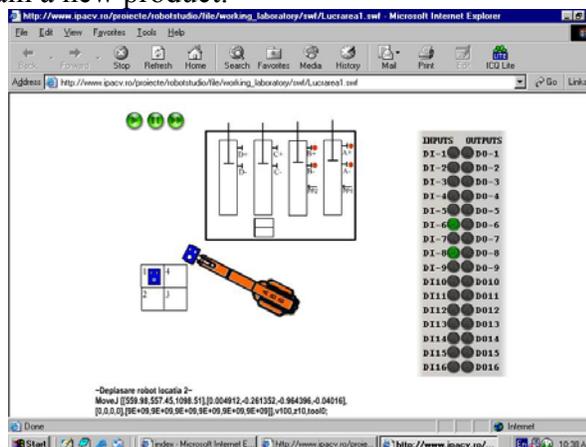

Fig 2.5

Flowing of the paralelipipedical pieces is supplied by the first two workstations and flowing of the cylindrical pieces from the last two workstation. All the pieces must be placed in specifically position known by the robot.

These two types of pieces are taken one by one by the robot and placed into the assembling place. Because of position's errors it's necessary for the robot to do two movements to arrange all the pieces in assembling place.

After that, the robot puts the new product in a matrcial storehouse with four locations. User can see a simulated application and sample code.

Welding operation
Purpose of work laboratory

Programming for the robot to do welding-line and welding-point simulation.
Section "Exercise":
Virtual Program Maker
This guide will familiarize you with Program Maker and provide the information you need to develop RAPID programs for the ABB S4 robot controller.

Program Maker, an ABB DeskWareTM application, is a development environment for creating, editing, and debugging RAPID programs for the S4 robot controller.

Virtual Console
This chapter describes how to programming a robots using Teach Pendant and offered possibility to test a Virtual Teach Pendant.

Using Virtual Console it's possibly to edit a program and testing with Virtual Robot Center and simulated application.

References

Hamburg, Ileana, 2003: **Verteilt und doch gemeinsam lernen**. In: Wissenschaftszentrum Nordrhein-Westfalen: Das Magazin 14, H. 1, S. 34

Hamburg, Ileana / Cernian, Oleg / Thij, Herbert ten, 2003: **Blended learning and distributed learning environments**. In: 5th International Conference on New Educational Environments: Lucerne, Switzerland - may 26-28, 2003; the know-how hub for blended learning. Berne: net4net, p. 197-202

Hamburg, Ileana / Cernian, Oleg / Thij, Herbert ten, 2003: **Lernen und Kooperieren in verteilten Umgebungen: die Chance für die betriebliche Weiterbildung!** In: Engert, Steffi / Hamburg, Ileana (Hrsg.): IT-basierte Lernformen für die betriebliche Weiterbildung. Gelsenkirchen: Inst. Arbeit und Technik, S. 45-55

JC Waller, N Foster: **Training via the web: a virtual instrument**, Computers and Education, 35, March 2000, 161-167

news.bbc.co.uk 2001: BBC **News Article – Virtual Lab brings Science To Life**, http://news.bbc.co.uk/1/hi/sci/tech/1111654.stm

physicsweb.org: **Virtual Interaktive Experiments**,

http://physicsweb.org/resources/Education/Interactive_experiments/

www.sci.brooklyn.cuny.edu/-marciano **Virtual Multi-Media Internet Laboratories**,