

Application of an OPC System for Mineral Extraction in a Copper Mine Laboratory Scale

Michael Valarezo, Estefania Salinas, Julio Romero, Diejo Jara.

Abstract—For their importance in the mining industry of copper in the south of the Ecuador, an application of a system of OPC is presented that transfers the copper mineral extracted using the action of a motor of C.A, which moves a transportable band. The programs MATLAB® and LabVIEW® possess an academic profile and for this reason, they have a very limited use inside this technology OPC. Also, these are part of the school formation of the students of the career of Electromechanical Engineering of the National University of Loja (UNL) in the Ecuador. Keeping in mind that pointed out, these programs will use the mark of the technology OPC in the process of extraction of the copper mineral. Finally, a comparison of the found results with these two programs is made

Index Terms—Data exchange, OLE, OPC Client / Server, PLC.

I. INTRODUCTION

At present, have developed some systems for communication equipment of different brands, this known as OPC (which is a protocol for open communication for all control systems), runs on client-server architecture. The server associated with the external hardware. As the PLC providing the service called "OPC Server" associated with a Windows application. Some systems use this technology as Brain Wave SAG mill, which is a unique program control using adaptive technology, and patented predictive models based control. The Brain Wave can make changes in the rotation of the mill, processing recycled pebbles, maintain the quality of the mineral, monitor the weight of the material in the factory and maximise production. When the driver makes adjustments in the level weight crystal fresh feed, a second brainwave adjusts the speed of the feeder to ensure that the correct amount of ore in the mill delivered. Because it uses a standard OPC connection, the Brain Wave easily integrates with your existing control system [1].

In the area of Sierra Gorda, in the Second Region of Chile, is the Spence, a copper mine opened in March 2007. This facility is 100% owned by Anglo-Australian company BHP Billiton, the largest diversified resources company in the world, a leader in Chile and second world producer of copper. It predicted that from late 2009, Spence would be producing

annually about 200,000 tonnes of copper cathodes during an estimated 19-year useful life.

Construction of the Spence copper mine in Chile accounted for the company BHP Billiton the project of the century, i.e., a unique opportunity to install technology such as OPC and the latest developments in the market.

The Open PCS7 Simatic PCS7 system tool facilitates data exchange with an OPC, which allowed the integration of an expert program developed in G2, to resolve what was the biggest challenge in automating the process of electro winning. The automatic operation of the crane for the collection of copper cathodes bridges is a task that only three plants in the world made automatically [2]. The OPC protocol used in the mining sector. However, the application of MATLAB® and Lab VIEW® of academic programs have very limited use of this technology. Given this, a research field for UNL graduates where they can try to incorporate the OPC protocol, using these two software packages opens.

In this work, we have a system server that provides a service, consisting of the Siemens S7-200, which is a programmable logic controller (PLC), which will operate as OPC Server with the application of microwin Step 7 MATLAB®. The server uses the PC-ACCESS program for communication [3]. All this is necessary to implement this technology. In the case of use of LabVIEW® program, this is the one to control and monitor data, being the OPC Client. It also allows all SCADA (Supervisory Control Systems and Data Acquisition) can access information general and abstract manner. In the LabVIEW® OPC Client installed with the Distributed Control System (DSC) module. For the use, you need to have activated the toolkit DSC or Datalogging as is known. Other servers installed with the Modbus communication protocol [4]. A portion of the OPC technology used in automated mining systems is conveyor belts, which are responsible for carrying material from one area to another in the production process. In many cases, are the mainstay of the continuing process, they move large amounts of material quickly and safely. One of its advantages is that workers benefit by reducing the amount of work done by hand, increasing the workload and performance of the production. The bands made with different characteristics according to the application [5].

Also through the OPC technology can be incorporated to process alarms, set the parameters and set the computer to be responsible for making viewing on a PC. For the OPC allow the client to communicate with the server, you must configure the server as host. The communication process involves the encoding and decoding of data for data transport between Client and Server An OPC client can connect via a digital communication network with OPC servers supplied by one or more manufacturers without any restriction due to the benefits of the software used.

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* Correspondence Author (s)

Michael Valarezo, Geology and Mines, University National of Loja, Loja, Ecuador.

Estefanía Salinas Nalvay, University National of Loja, Loja, Ecuador.

Julio Romero, Geology and Mines, University National of Loja, Loja, Ecuador.

Diego Jara Delgado, Geology and Mines, University National of Loja, Loja, Ecuador.

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II. MATERIALS AND METHODS

MATLAB®, LabVIEW® [6, 7]: For the development of this article several programs, which used. PC access for communication and microwin version 4 to develop the program, which will then downloaded to the PLC of SIEMENS [4.2]. The proposed system is discreet (all or nothing). The list of all equipment used shown in Table I.

Table 1. Equipment used

Quantity	Name	Mcharacteristics	Description
1	Motor of C.A	1½ Hp	Motor to move a band
1	pulleys	Relation 11 to 1	To reduce the speed of rotation of the motor is transmitted to the band
1	PLC	Model 224 the S7-200	digital inputs / outputs are used
1	Power supply	To 24 volt DC	Since the PLC operates at 24 volts needed an external source
1	Conveyor belt	Iron structure and material of the leather band	

Below is shown in Figure 1 All These computers and the conveyor belt driven by a pulley 11 times you reduce the rotational speed it off the engine shaft C.A

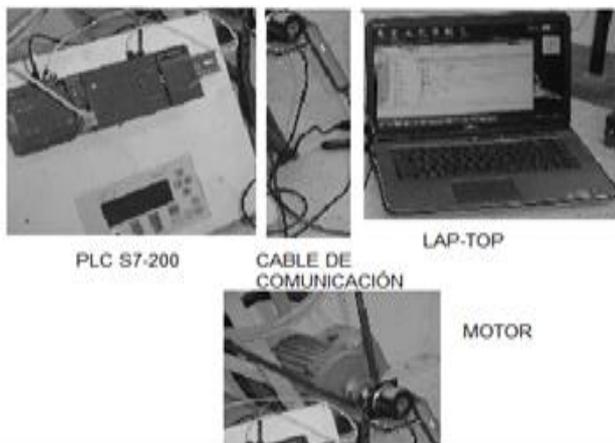


Fig 1. This figure shows the equipment used in this work.

A. Communication with Siemens S7-200 PLC using MATLAB®.

For this communication, the following procedure Followed:
 1. MATLAB® and Windows command window open, the control OPC tool. Then the wizard that will allow OPC Client configuration written Appears.

2. Once the STEP 7 program (SIEMENS Developing our program That Allows applications) proceed to save and download it to the PLC Executed.

3. Next, run the PC ACCESS V1.0, Which is the version That Was the Relevant tests performed.

4. The program imported from the PC ACCESS as shown in figure 2 where you can see the program.

5. When you turn on the keypad start, the program starts.

6. That brand drives a timer and two seconds off the engine activated.

7. Downloaded the Micro WIN SIEMENS and PC -ACCESS enabled, Begins execution.

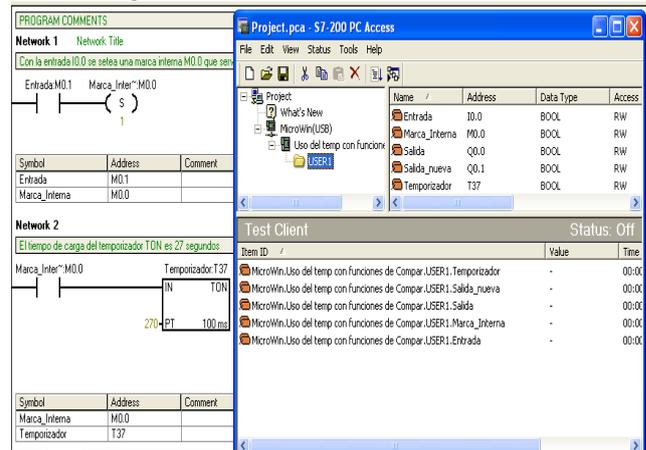


Fig 2. Microwin interaction and PC Access

It is Important to note that the entries in the program made with the MicroWin S7-200 Should be taken as trademarks because they are virtual. If you want to work with both actual and virtual signals both, it is imperative That connected in parallel. This work in the virtual signals taken.

- In the open window with the command, OPC tool proceeds to identify the host server, which will be called by default localhost.
- To the right of the screen displays all S7 OPC Including Existing servers Server 200 SIEMENS.
- At this point, you must connect the server and add a group of variables OPC Client MATLAB®.
- Are called one by one and given values of 1 or 0.
- For PLC inputs are incorporated they must be in RUN They mode, as shown in Figure 3

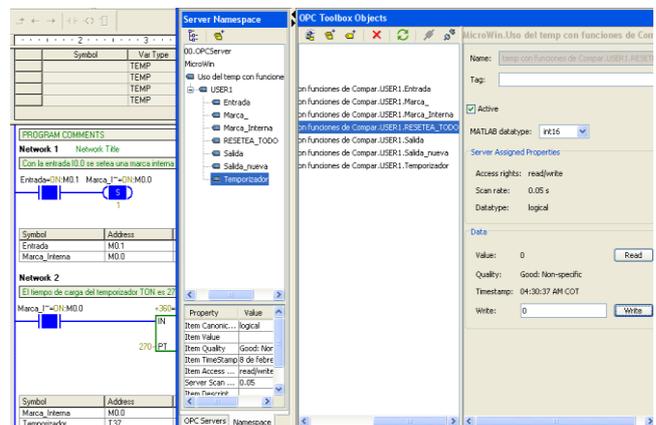


Fig 3. Client Server windows in MATLAB®

B. Communication With Siemens S7-200 PLC using Lab VIEW.

National Instruments is the company markets the LabVIEW®; OPC Server is available, which Allows the link and the exchange of data THEREFORE Between no matter who 'client/server', without any restriction.

1. Activated in the Project Explorer window, to specify thereby the OPC Server That should work.



2. Then input -output (I / O) selected because you Work With servers.
3. Variable selected, and it managed from the LabVIEW®.
4. After defining the variable a new Virtual Instrument (VI) is opened, so That the varying found now, whatever ITS type to communicate. Is verified by the data transfer operation of simulating one of the inputs of PLC [8].
5. Then, the variable name changed to "Test Procedure" and runs in the open LabVIEW® VI, as shown in Figure 4.
6. Communication with the different process presented, In This case, a signal between variables; Which Keeps LabVIEW® is taken, and can observe the PLC as if you were who's working in any process.

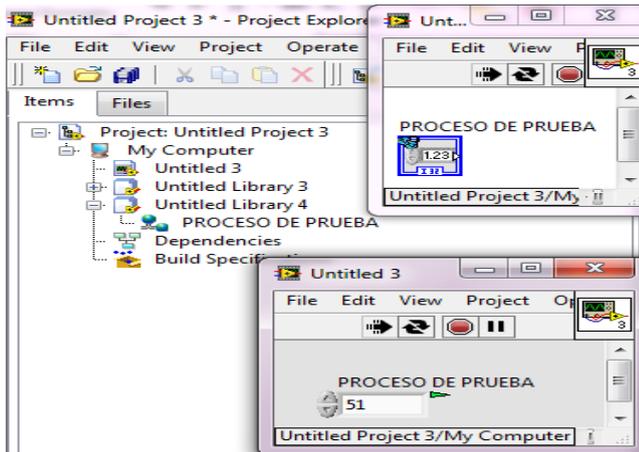


Fig 4. LabVIEW® window with variable Testing Process

C. Communication with Siemens S7-200 PLC, NI OPC Server 2012.

It is Important to note today's PCs That Do not have RS - 485 port and need to buy a USB adapter -485, such as National Instruments (NI) or design one That was what done for the development of tests of estate work. As it shown in Figure 5.



Fig 5. Equipment and cables used in communication with MATLAB® or LabVIEW®.

PLC OPC Server configured, and this is called the OPC Server (NI), Where They will set up your drivers to use the Siemens S7-200 PLC and the OPC Client (NI). Henceforth, the same as was done in the previous section, Where variable is selected and can manipulate from variable LabView observing the change in the PLC [9] is Repeated.

The elements shown in Figure 6 Where the selected variable "Daisel" is, for motor control from LabVIEW®. This change reflected in the SIEMENS STEP WIN [10].

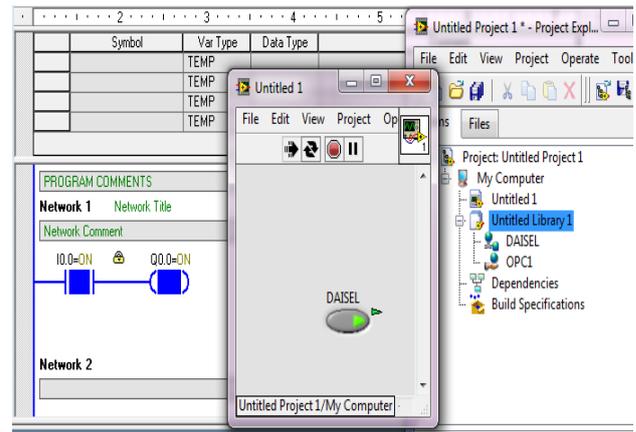


Fig 6. The end result of communication from LabVIEW®.

In this way, communication between the OPC Server and S7-200 PLC achieved, when I command it from LabVIEW® since it is the customer. This shown in Table II

Table II. Results of analysis of communication between MATLAB® and LabVIEW®.

	Software	Hardware	CLIENT	SERVER
MATLAB® 2012 a	PC-ACCESS, MATLAB®, STEP 7 MICROWIN	PLC S7 200, 24 V power supply, communication cable, PC	MATLAB®, OPC CLIENT	OPC SERVER, SIEMENS PC-ACCESS
LabVIEW® 2012	LabVIEW®, STEP 7 MICROWIN	PLC S7 200, 24 V power supply, communication cable, PC Special	OPC / CLIENT LabVIEW®	OPC/SERVER DE NI

Then information can be very useful That When Working with any of these alternatives summarized.

1. -Using the PC version since version V1 V3 ACCESS gives some compatibility problems When Communicating with MATLAB®.
2. If you are starting a new ACCESS PC application, you must exit the previous tests, making sure it is not the icon indicating that this window enabled at the bottom.
3. To have allowed the OPC Lab VIEW® Previously the DSC module (NI Known as Lab VIEW®, monitoring and control module), ideal for data records must Developing Applications be installed.
4. Working with brands or virtual type designated by M0.0 tickets, if IO.0 is placed because, you are working in When virtual mode, as extra work Gives problems. But if you want to work with real inputs They can be connected in parallel With These manufacturer's recommended numbering.

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5. There are certain restrictions to be taken into account when working with PC ACCESS, especially with the PLC-1200, as originally thought in the S7-200 PLC range.
6. The wire connection can be made or designed by the user, but for industry, applications are convenient to work with equipment designed for estate case, with the manufacturer provides That Guarantees.
7. It is Important to Have enabled PC ACCESS SIEMENS because it will not communicate with the OPC client, in which case would be extra That MATLAB®.
8. Once the primary variables to use, easy to it Maybe as detect from LabVIEW® With SCADA.
9. In the MATLAB®, there is a real Possibility of OPC configuration. Simulink Also provides some possibilities to do This, Which is left as a recommendation to deepen the OPC communication Content of this program.
10. NI (National Instruments) Allows only LabVIEW® Work With your software, as it only has to activate the OPC Server from the same library for communication and from there the OPC Client. but the disadvantage of the PLC Arises communication. For extra two possibilities handled or purchase a serial communication wire or make NI sells That One with the design specifications shown in estate direction.
11. This work is the student knows Intended That the OPC Technology and Its applications with the tools that are in class.
12. Make better use of the tools of MATLAB® and LabVIEW® programs for controlling in mining engine: such as copper.
13. Link to the student, with the teams That Counts, the UNL.
14. In Figure 4 you can see part of the algorithm used to check that was C.A which engine developed in the STEP - 7 Siemens.

III. CONCLUSIONS

- ✓ The results will enable the student Obtained at the National University of Loja, better Understand how you can link two major programs: such as MATLAB® and LabVIEW®, with a firm: such as SIEMENS and is used in copper mining very often.
- ✓ Use of communication protocol OPC It Easier for students to have a global vision, of how devices from different manufacturers communicate, as happens in reality, there is not only Where sensors, actuators, PLC, etc. It became a single distributor.
- ✓ The OPC Client Server concept will help the student to Understand that topic is of great Importance in Industrial Communication, Communication between applications: such as through simple example of motor control.

REFERENCES

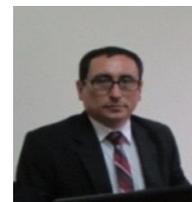
1. Andritz Automation, «Solución de control para molinos SAG,» [En línea]. Available: <http://www.andritz.com/de/aa-brainwave-sagmill-spa.pdf>. [Último acceso: 2015 Mayo 29].
2. SIEMENS, «Un Sistema de Control de Procesos a la altura del proyecto minero Spence, Tecnología Minera,» 29 Mayo 2015. [En línea]. Available: <http://www.tecnologiaminera.com/tm/novedad.php?id=76>. [Último acceso: 2015 Mayo 29].
3. ¿. s. p. a. a. u. P. S.-1. m. u. P. A. y. q. s. h. d. t. e. cuenta?, «SIEMENS,» 08 Agosto 2014. [En línea]. Available: <https://support.industry.siemens.com/cs/document/41928929?dti=0&lc=es-WW>. [Último acceso: 2015 Mayo 26].
4. N. Instruments, «Comunicación del S7200 de SIEMENS con OPC Server,» [En línea]. Available: <http://forums.ni.com/t5/Discusiones-sobre-Productos-NI/Comunicaci%C3%B3n-del-S7-200-de-Siemens-con-NI-OPC-Server-2009/td-p/1690440>.
5. M. d. Carmen, «Control PID de la velocidad de una banda transportadora para clasificación de objetos,» 2008.
6. Mathworks, «Mathworks,» [En línea]. Available: www.mathworks.com.
7. N. Instruments, «National Instruments,» [En línea]. Available: www.ni.com. [Último acceso: 10 octubre 2013].
8. J. O. Caizaluisa, Escritor, Dosificador y Comunicación OPC LabView. [Performance]. Universidad Pontificia Salesiana, 2013.
9. LabView-OPC-PLC. [Performance]. 2011.
10. N. Instruments, «Comunicación del S7-200 de Siemens con NI OPC Server 2009 mediante el cable USB/PPI,» NI, 31 Agosto 2011. [En línea]. Available: <http://forums.ni.com/t5/Discusiones-sobre-Productos-NI/Comunicaci%C3%B3n-del-S7-200-de-Siemens-con-NI-OPC-Server-2009/td-p/1690440>. [Último acceso: 18 Mayo 2015].



Michael Valarezo received the title of a mining engineer, at the Universidad Nacional de Loja, in the province of Loja Ecuador in 1998, through interinstitutional agreement with the Instituto Superior metallurgical and mining of Cuba has a Master's Degree in Environmental Management. Its interest in the field of research concerns the behavior of the practice and its involvement in Geotechnics and natural hazards.



Estefania Salinas received Engineering degree in Systems from Universidad Nacional de Loja, Loja, Ecuador, in 2015. She is a research interest in network security and comunicaciones.



Julio Eduardo Romero Sigcho received the title of a mining engineer, at the Universidad Nacional de Loja, in the province of Loja Ecuador in 2001, Master's degree in Environmental Management. I am interested in research in the mining field, environmental and new environmental technology for mining development



Diego Jara Delgado received the title of Chemical Engineer, State University of Cuenca, in the province of Azuay, Ecuador in 1979 has a Master's Degree in Educational Research University Teaching 2002. His interest in the field of research in thermochemical and practice with projection to the empowerment of new forms of energy