Application of serial communication in industrial automation processes

Wilver Auccahuasi[a], Kitty Urbano[b], Christian Ovalle[c], Marco Felippe[d], Orlando Pacheco[e], Manuel Bejar[f], Carlos Ledezma[g], Amaury Farfan[h], Edwin Felix[i] and Mario Ruiz[j]

abcdefghij *Universidad Continental, Huancayo, Perú*

Abstract
In the field of engineering, the most required mechanisms are those in charge of the transfer of information, between the different components of the equipment or system, as well as the exchange of information between the equipment and the different control or management systems is required, that it is required to know the status of the equipment. These requirements are important to be able to measure the performance of the equipment and we need to have the information, one of the protocols that we have available is the serial communication port, through the RS-232 protocol and with the DB9 serial connector and now the USB, in The present work presents a method to exploit this data that we can export through this port as well as the description of an application made in Labview to connect to the equipment by configuring a virtual port "COM3", from which we can receive the information and its subsequent storage and exploitation, the results show that it can be connected with all the equipment that has the serial communication port and by the labView development tool it allows us to connect with different hardware architectures and with greater compatibility with serial communication.

Keywords 1
RS-232, communication, protocol, connection, transmission, reception.

1. Introduction

In the development of software dedicated to industrial automation, the communications port assumes the responsibility to be able to export and import data, in this task we find different jobs dedicated to the study and application of the protocol, we have jobs where we try to connect equipment with more than 20 years of manufacture, for which it is important to know the equipment design protocol and mainly the compatibility with current protocols, one of these important considerations in the transmission speed presented by the first designs, such as 50 baud and being able to update to the 9600 baud rate that the equipment currently works with [1]. Due to the diversity of equipment that we find in companies, most of them have to perform signal conditioning to try to make it compatible between the RS-232 protocol and the GPIB [2]. We can also find low-cost solutions to ensure the compatibility of the RS-232 protocol with its different variants that use the DB-9 and DB-25 connectors where the transmission and reception pins are mainly used [3]. Many of the current solutions are dedicated to working in operating systems such as Linux, where conditioning, transmission and reception devices are developed, using microcontrollers that take advantage of the serial communication characteristics presented in their architecture [4].

From the point of view of application development, we can find that most programming languages have their own libraries for serial communication integrated as well as the availability of open source libraries that can be used without problems [5]. In the market we find many communication protocols,

each one dedicated to the specific tasks of each equipment, where they use TCP as an alternative protocol, achieving compatibility with the MODBUS protocol, in this sense it is recommended to know the technical details of the equipment's communications module [6]. The RS-232 protocol continues to be used today for its practicality in its implementation and is being used as the main communication medium coupled to real-time transmission systems based on the use of FPGAs [7] [8]. The use of PLC is commonly used in the industrial field as a standard, most of these equipments have the serial communication protocol, managing to integrate with other equipments both for transmission and reception as well as to form industrial communication networks [9]. Currently, the equipment is configured in such a way that it can be controlled remotely and can see its operation, for this reason serial communication is used to export information from the equipment and that these can be presented through various solutions to be able to observe them at distance [10].

2. Materials and Methods

In order to develop the methodology, the following three stages were designed, which are presented in figure 1, where each of the stages corresponds to an essential process in the fulfillment of the objective, the results of each stage serve as input for the next stage, that is It is necessary to have the necessary equipment and the necessary wireless connection, in order to demonstrate the use and application of the methodology. Each of the stages is developed below, describing the elements necessary for its application, as well as the application and the results we hope to obtain.

Figure 1: Block diagram of the proposed methodology.

2.1. Study of the problema and alternative solutions

For the application of the methodology, it is required as a first measure to be able to know the problem and with it to be able to analyze the possible solutions, in this sense the first thing that we must take into account to know at a level of detail the causes that are making the failure possible. equipment connection.

It is recommended that a checklist be made to have an overview of the problem and the mechanisms that we can provide to solve the problem. For our case, and for the purpose of being able to check the methodology, the example problem is described: there is a team related to the measurement of energy consumption where it is required that this consumption information can be observed in another environment in order to be able to monitor how the team is behaving.

Analyzing the problem and the team, the following data is obtained:

- The equipment monitors energy consumption, in its architecture a DB-9 connector can be displayed.
- Need to export information on energy consumption to an administrative environment.

2.2. Proposal Design

In the second process of the methodology, what is available is evaluated, making a visual recognition of the components and connectors and a review of the technical specifications of the equipment, in this analysis in figure 2, where the control module of a piece of equipment known as an electrical substation, it can be noted that the equipment has a DB-9 connector, reviewing the technical

specifications of the equipment, the communication module allows the export of information based on the behavior of the equipment with two indicators of consumption, first we have the output voltage and current consumption, these two values can be obtained by reading from the DB-9 connector.

Figure 2: Image of the equipment with its DB-9 connector

As the equipment presents two values that can be exported, a second step is to be able to determine how the transmission frame will be so that it can be interpreted by the application to be developed, in this sense we proceed to have a design of the transmission frame and it is made up of the following data:

- Time and date: provided by the control system itself.
- Voltage that the equipment is sending.
- Current that is being produced with the load that is feeding the equipment

With these values the plot of the equipment is defined as follows:

Figure 3: Image of the conformation of the communication protocol frame.

Time and Date	Voltage	Current
5/04/2021 15:00	220	3.5

In image 3, it is presented how the frame that will be sent through the serial port through the DB-9 connector is constituted, you can also see an example of the value that is sent, for its subsequent interpretation, a recommendation that must be taken It is to be able to know how the plot is constituted, it is very important because when the plot is recovered the next process is to be able to interpret the plot, if we do not know the order and that each value corresponds, it is very difficult to be able to solve the problem that it gave origin to the design of the solution.

2.3. Application Development

In order to solve the proposal, the next step is to implement an application where you can have the following processes so that you can view the operating variables of the equipment, the tasks that were designed are the following:

- Connection with equipment
- Frame reception
- Storage in a file of the plot for later analysis.

In the description of the necessary tasks and processes, it is required to connect with the equipment, to retrieve the information and to be able to store it for later exploitation. The sogtware for the development of applications for engineering called LabView was used, where it will be used to solve these three tasks and to be able to present in a single application the evidence of the connection, transition and storage of the data.

In figure 4, the user view of the developed application is presented where you can view the different configurations that can be made as well as the parameters to save the information based on being able to store it in a file with a CSV extension.
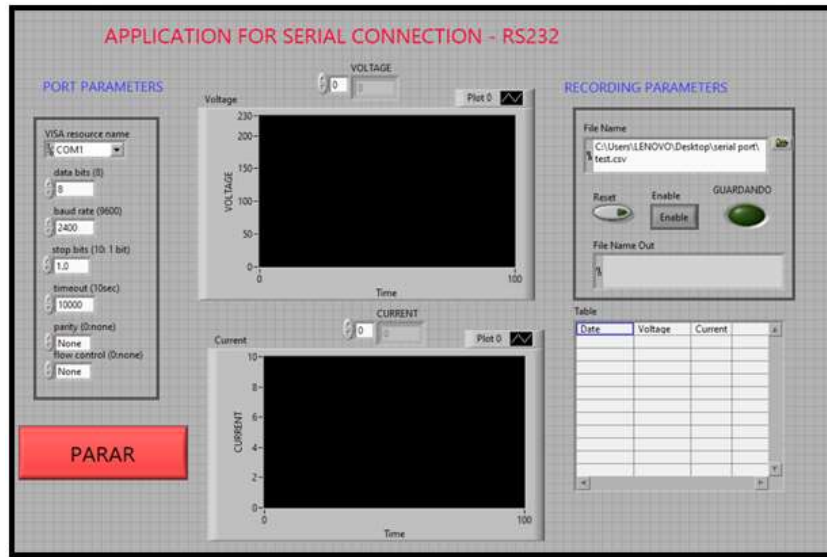

Figure 4: User view of the application developed in LabView.

In figure 4, you can see the application developed in Labview, where for our particular case, the recording of the voltage and current values was considered, each of the values is separated and shown in each graph, it is also presented the parameters to save the data, the parameters of the communication port, and finally a table where the data can be presented as it is being received and stored.

3. Results

The results presented are related to the design of an application developed in labView to be able to solve the problem related to the connectivity of the equipment to a workstation, from where you can view the consumption values as well as the time stamp. and registration date, it is important to indicate as a result that the information that can be sent through the serial port will depend on the specifications of the equipment manufacturer, because it is not totally sure that all equipment dedicated to the industry can have the serial port enabled , It would be advisable as a purchasing strategy to define in the specifications when looking to acquire equipment that can be exported as much information as consumption, performance and failures in such a way that they can be exported and their subsequent analysis, having the information can be perform many solutions and perform predictive mechanisms and this is achieved with info historical confirmation, hence the importance of exporting data.

In figure 5, the developed application is described, where an explanation of what each of the fields consists of is made in order to know and that this application can be scalable towards solving other problems.
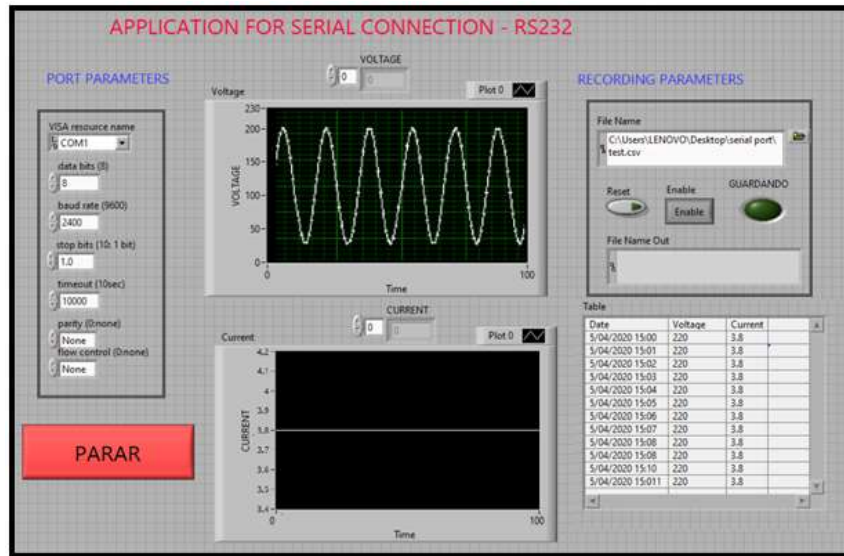
Figure 5: View of the execution of the developed application.

In figure 5, we can observe the execution of our developed application, according to our needs, below we describe the main characteristics of the application:

- From the point of view of the communications port parameters, depending on the equipment we are connecting, we must obtain these parameters, to have a reading without loss of information we must know the name of the virtual port, known as "COM1", the The number of bits is important because it will allow obtaining the value of the information without being distorted in the reception, the speed is important because it allows synchronizing and balancing the data reading when they are synchronized at the same speed, the stop bit is important as well as the parity bits for the control stage.
- From the visualization point of view, two graphs of the acquired values are presented, one is the voltage that is presented as an alternating wave with average values of 220 volts, as well as the current with a constant value of 3.8 amps.
- From the point of view of the parameters to store the information, we present the location where the information is stored by means of a CSV file, presenting an alarm-type visual signal that indicates that the information is stored and finally provides us with the name of the file.
- From the point of view of the values that are being stored, the information in a table is presented as an evaluation mechanism, as the data is being stored, a characteristic to evaluate is the information of the data where it is stored at a frequency of 60 Hz, since the information presented contains 1 set of voltage and current values for every second of record.

4. Conclusions

The conclusions that are reached at the end of the research, where we can indicate that in the matter of industrial automation, connectivity is very important and modular in the integration of systems and with it the possibility of scaling, making a review of the activities carried out in the process of checking the methodology, we can define and conclude on the following points:

- **Hardware:** we find a number of computers that have many communication protocols, among them the serial protocol based on RS-232 is the most used and easy to implement, in most cases it can be considered a standard for ease and compatibility with most of the current equipment and those that have been on the market for a while.

159

- **Software:** we can mention that there are a number of computational tools on the market that allow us to implement the protocol, among which we can mention are those that are installed in most computers, most programming languages have communication libraries Among them, serial communication, the one we recommend for its practicality and easy implementation is LabView because it allows us to connect with a large amount of hardware through its different communication protocols.

We can indicate that in the market for equipment related to the industry, most equipment is based on PLC, to be able to integrate these equipment into an industrial network where we can share resources as well as monitor the operating parameters, intracion through the RS-232 protocol is necessary and as a contribution we can indicate that most PLC equipments allow an alternative communication based on RS-232.

In order to test our methodology, a device that provides energy was chosen, known as substations, where the control unit has a serial connection, the study was carried out, communicating with the equipment and exporting its data, thanks to the application developed in LabView which also allows storage.

We finally conclude that the methodology can be used and scalable, applicable to any equipment that has a serial connection, and with the hardware that can be connected as well as a variety of software that is available, with which we can export information for later exploitation.

5. References

[1] Saboya, N. (2012). Normas de Comunicación en Serie: RS-232, RS-422 y RS-485. Revista Ingenio Libre, 9(1), 86-94.
[2] Neer, G. F., & GENESIS, G. Aplicaciones del software LabView en electromedicina. Universidad Tecnóloga Nacional de Argentina2003.
[3] Caicedo Mejillones, S. K., Paredes Cedeno, J. M., & Ponguillo Intriago, R. (2014). Analizador de protocolo rs-232.
[4] Gómez, J. G., Torres, A. P. M., & Tecnologías, I. (2004). Herramientas hardware y software para el desarrollo de aplicaciones con Microcontroladores PIC bajo plataformas GNU/Linux.
[5] González Martínez, Y., Castillo García, M., & Silva Quevedo, Y. (2014). Componente para la lectura de datos por alas-HIS desde máquinas de anestesia. Revista Cubana de Informática Médica, 6(1), 110-117.
[6] Olaya, A. F. R., López, A. B., & Moreno, F. G. G. (2004). Implementación de una Red MODBUS/TCP. Ingeniería y Competitividad, 6(2), 35-44.

[7] Miguel, E. E. C., & Reséndiz, J. R. (2018). SISTEMA DE MONITOREO EN TIEMPO REAL BASADO EN FPGA PARA LÍNEAS DE TRANSMISIÓN. Pistas Educativas, 38(119).
[8] Nieto, L. S., Huavel, E. Z., & Laya, Y. A. Automatización de la Gestión del Almacén del Laboratorio de la FIEE. Electrónica-UNMSM, (25), 47-54.
[9] Filgueira, G. G., & Domínguez, M. R. Sistema de Monitorización y Asistencia de Fondeo para Embarcaciones.
[10] Bernal Bermúdez, J., Gutiérrez Rodríguez, A., Bobadilla Sancho, J., Tejedor Cerbel, J., & Sánchez Sánchez, J. L. (2005). Laboratorio Remoto mediante JSP para el acceso a hardware específico. In XI Congreso Argentino de Ciencias de la Computación.