Technology PLC - Power Line Communication, Used in Monitoring Systems Online.

http://dx.doi.org/10.3991/ijoe.v9iS1.2283

V.Gruber[1], R. Marcelino[1], Silva J.B.[3]
[1] Universidade Federal de Santa Catarina, Criciúma, Brazil
[2] Universidade Federal de Santa Catarina, Araranguá, Brazil

***Abstract*—This paper is developing a system for monitoring, supervision and acquisition parameters using Power Line Communication technology. The system consists of a web microserver using the power grid for the transmission and reception of data through technology PLC (Power Line Communication), as a solution for remote monitoring of temperature parameters of a mini turbine bench. In this article were performed comparative tests between the PLC and LAN technology in two distinct environments: residential and industrial. The analysis of network behavior was conducted through a network analysis software, which were established parameters that represent network performance when sending and receiving data from the monitoring system. Data obtained from this study show satisfactory results of PLC technology in relation to LAN, confirming the possibility of using this technology as an alternative to online monitoring systems.**

***Index Terms*—Wind Power, PLC, Monitoring online**

I. INTRODUCTION

Providing platforms for monitoring, supervision and control of online data in machinery and equipment in real time, is not an easy task. In investment strategy, choosing appropriate technologies, and the means to establish this communication in the integration of various equipment distributed in different locations "remote" is an important factor for the success of the data that want to monitor. The information and communication technologies bring very interesting features that can be applied in the integration of various technological systems, the distance learning and experiments. The Internet has contributed to the expansion of these resources in the area of monitoring, control and experimental data, increasing the performance of remote experiences and thus establishing new learning paradigms. This article shows you work on a prototype of a system for monitoring and data acquisition using power line communications - PLC, applied to monitoring, procurement and supervision of the rotor temperature of a small wind turbine. Thus one seeks to acquire and analyze this data the operation of the wind turbine so as to generate information quickly and reliably providing a database for easy access. The remote monitoring aims to provide agility and flexibility in production planning. (GRUBER, V. ; SCHAEFFER, L. ; SILVA, J. B. ; CASTELAN, J.; RESTIVO, M. T. B. V. A. ; SPACEK, A.). Throughout the supply chain, monitoring enables quick responses to changes and delays at different points in the chain. The analysis of information makes it possible to diagnose problems during the process and correct them quickly and easily and purchasing systems and monitoring data online (MARCELINO, R. 2007) how good can still say that an activity based on an experimental remote laboratory may provide students with an approximation of the real world, since the laboratory activities play a critical role in the formation, especially in courses in the natural sciences and technology and also represent a way to share resources, so reduce costs for these resources on the part of educational institutions in addition to being a factor of enrichment of the educational experience. (SILVA, J. B., 2006)

II. OBJECTIVES AND MOTIVATION

This work aims to study and develop a monitoring system for data acquisition, monitoring and supervision of rotor temperature of a small turbine through a prototype using simulation as a means of communication Networks PLC. The steps of this work can be seen in the flowchart in Figure 1.

III. TECHNOLOGIES USED

System with a structure consisting of sensor elements, data acquisition board, electronic circuit interface, microcontrolers(SANTOS, J. C. S., 2009) transmission equipment and receiving power line (PLC) as can be seen in Figure 02 and still management software comprising an HTML page shown in Figure 02.

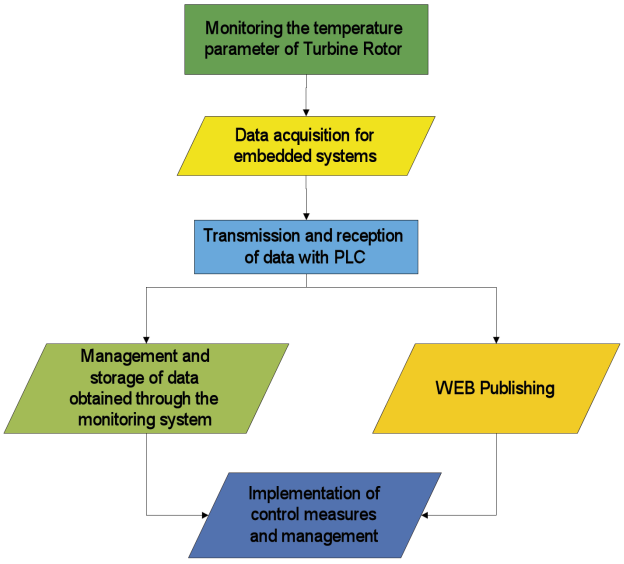


Figure 1. flowchart motivation

IV. DEVELOPMENT

The performance evaluation of PLC technology was performed by network parameters "set" the software in use: PRGT Network Monitor (MIZUTANI, M. Et al., 2010). The same is installed in the notebook, which in turn is connected to the data acquisition board through the power grid. The software automatically detects any connected equipment and identifies the network, (TANENBAUM, A. S.; SOUZA, V. D., 2005). In the case of the test data acquisition card is identified as Microchip, as can be seen in Figure 03.

In this case, three parameters were added, namely: ping, HTTP and HTTP full page, which can also be observed in Figure 03 and then two scenarios were evaluated.

V. RESIDENTIAL SCENARIO

As a model of a residential setting, we use a low house, with standard wiring applied in Brazil. The facility is fed from the secondary distribution network of local utility, whose standard voltage supply for this level is 220V (Phase / Neutral) and 380V (Phase / Phase). Apects of loads coupled to the internal circuitry of the installation also adopt the pattern usually found in homes of this type in Brazil: electronics, appliances varied, washing machine, refrigerator, computers, air conditioner, electric faucet, shower and electric lamps (incandescent and fluorescent).

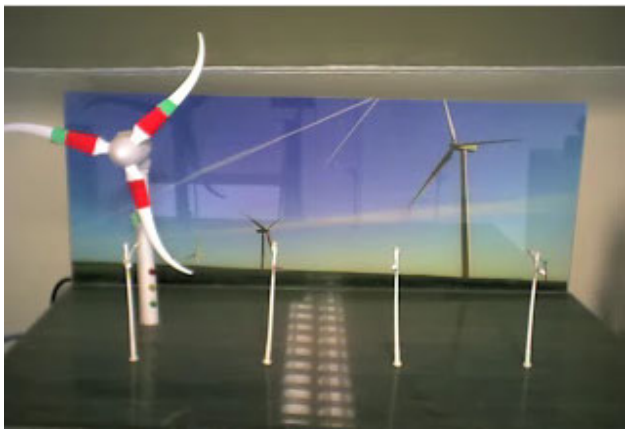


Figure 2. Simulation prototype

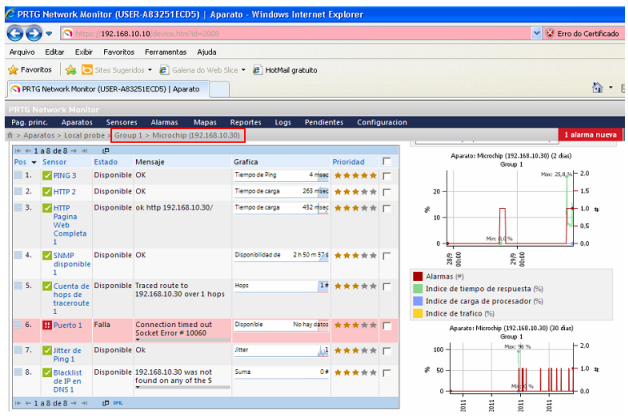


Figure 3. Network Analysis Software

VI. INDUSTRIAL SCENARIO

To represent the industrial scenario, we used the facilities of a laboratory on the campus of SATC School, where classes are held machining, since the room is composed of a CNC lathe equipment with engine power of 1500W, a center machining - milling also with the engine power of 1500W and a robot, where the PLC equipment were installed, making the network in-Home PLC. The machines available in industrial environments can be seen in Figures 03 and 05.

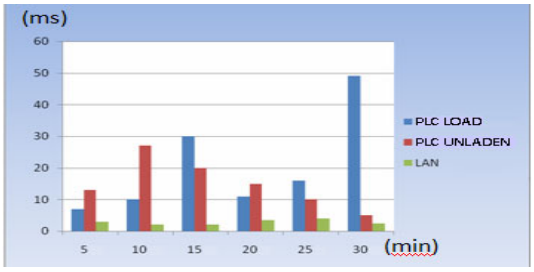
VII. RESULTS

At this stage, the results of the experiments performed are shown with the intention of looking at the performance of a PLC system operating in electricity grids. The results of each parameter will be presented below based on the three tests performed in the residential and industrial scenario respectively, allowing a comparison between the technologies used.

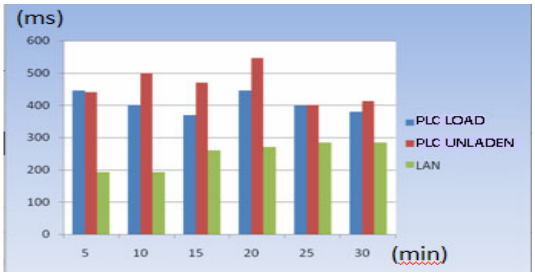
As shown in graph 1, the response time obtained in the 3 tests, involving the 3 technologies in the residential scenario, pointed to the LAN network as presenting the best performance, but the difference is not significant compared to the other technologies involved. Thus the response time of the PLC technology in this condition was considered satisfactory, and did not at any time compromise the data transmission.

Figure 4. Machining Center and Figure 5. Robot

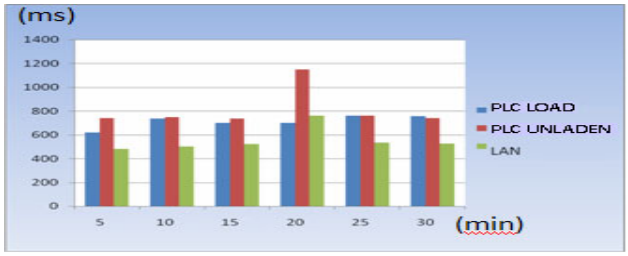
GRÁPH 1 – RESULT OF THE RESIDENTIAL TEST: PING PARAMETER



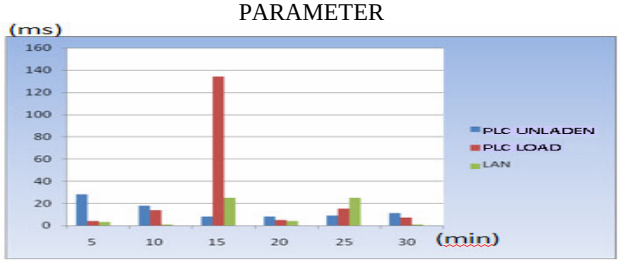
GRÁPH 2- RESULT OF THE RESIDENTIAL TEST: HTTP PARAMETER



GRAPH 2 – RESULT OF THE RESIDENTIAL TEST; FULL PAGE HTTP PARAMETER



GRÁPH 4 – RESULT OF THE INDUSTRIAL TEST: PING PARAMETER



In the case of the HTTP parameter, the latter is connected to the HypertextTransfer Protocol, which conditions the changes achieved in Page HTML during the test. In graph 2 it can be seen that the increase in the response time occurred 20 min into the test, where temperatures were captured, and these changes are picked up and sent to the HTML page. Since HTTP deals with transfers, it is consequently the period in which there were the most changes in the page. However, if the relationship between the three technologies is observed, the LAN network presents the best performance, but the difference between them, although sometimes significant, did not present problems in the responses of the commands, nor in the insertion of data into the Page.

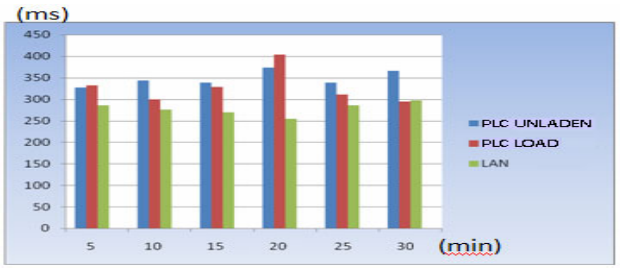
Graph 3 shows the results of this parameter, confirming the results of the previous parameters, except 20 min into the test, where the loaded PLC network presented a better result.

As shown in graph 4, the response time obtained in the 3 tests involving the 3 technologies in the industrial scenario presented a differentiated result. In the universe of 6 time samples subdivided in the test, 4 confirmed the LAN network as having the best peformance, while in 2 other samples, the unloaded PLC technology obtained a positive result surpassing the other technologies. IT should also be recalled that the samples to which the good results of PLC refer, occur at the times of data transmission, confirming, in this condition, superiority in the situations in which one wishes to send data and activate remotely in industrial scenarios.

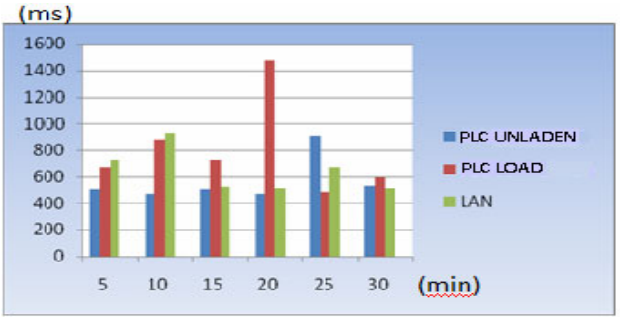
Graph 5 shows surprising results, if analysis is performed based on the changes in the page. The increase in the response time occurred 20 min into the test, while the activation and commands performed occurred 15 and 25 minutes into the test. The most similar results until that point were obtained observing the three technologies.

As in the previous parameter, the worst result appeared 20 minutes into the test without any justification, since the greatest changes were in the 2 other moments already mentioned. Against all the other tests, the LAN network did not obtain such good results, on the contrary, the unloaded PLC technology was outstanding in 4 of the 6 samples. This even further proves the efficacy of the technology in industrial environments and confirms the success of the results which could be seen using the prototype, where at no time did some activation fail to take place.

GRÁPH 5 – RESULT OF THE INDUSTRIAL TEST : HTTP PARAMETER



GRÁPH 6 – RESULT OF THE INDUSTRIAL TEST: FULL PAGE HTTP PARAMETER



VIII. CONCLUSIONS

Future prospects of existing technologies are the unification of the different networks of access to telecommunications, including cell phone networks, PLC, wireless, satellites and fiber optics, in the different existing technologies. Not only the fixed cell phone public networks will be integrated, the wide area networks (WANs) will also be interconnected, allowing the connection of laptops and other devices to infinity of new wireless service providers, practically anywhere in the world.

Among the items proposed since the beginning of the project, it is concluded that the results of all tests performed were satisfactory. The project proved versatile because, since they are communication systems, it can easily be adapted for implementation of remote automation systems for the different sectors of the Market and the industry at large.

The use of sensors together with other applications was an important tool for the diagnosis of non conformities and problems in the process. The study also confirms the ease of remote interactions with equipment, using PLC technology, besides allowed a series of possible applications in different fields of activity.

It is also considered that the PLC technology performed well under the conditions in which it was tested, proving its efficiency and the possibility of use in the different segments of remote monitoring.

REFERENCES

[1] GRUBER, V.; SCHAEFFER, L.; SILVA, J. B.; CASTELAN, J.; RESTIVO, M. T. B. V. A.; SPACEK, A.. Monitoring Small Wind Turbine using 3G Cell Phone Technologies. Far East Journal of Electronics and Communications, v. 5, p. 67-78, 2010.

[2] MARCELINO, Roderval. Aquisição de dados e monitoramento remoto aplicado a indústria metal-mecânica: Aerogeradores. 2007. Dissertação (Mestrado) - Departamento de Minas, Metarlurgia e Materias, Ufrgs, Porto Alegre, 2007.

[3] MIZUTANI, Mikio. Et al. "Network-supported TCP rate control for high-speed power line communications environments". Department of Computer Science and Electronics, Kyushu Institute of Technology, 680-4, Kawazu, Iizuka, Fukuoka 820-8502, Japan. Elsevier, 2010

[4] SANTOS, J. C. S. Projeto de um sistema microcontrolado utilizando Internet embarcada para monitoramento remoto em tempo real de temperatura e disponibilização dos dados na WEB através de conexão de rede. Natal, RN. Trabalho de conclusão de curso. Universidade Federal do Rio Grande do Norte. 2009.

[5] SILVA, J. B.. A Utilização da Experimentação Remota como Suporte para Ambientes Colaborativos de Aprendizagem. Florianópolis, 2006.

[6] TANENBAUM, Andrew S.; SOUZA, Vandenberg D. Redes de computadores. 4ª ed. Rio de Janeiro: Campus, 2005. xxi, 945 p

AUTHORS

V. Gruber , is a researcher at Universidade Federal de Santa Catarina (UFSC), Telecommunication Araranguá, Brazil. (e-mail: vilsongruber@msn.com).

R. Marcelino, is a researcher at Universidade Federal de Santa Catarina (UFSC), Industrial Automation, Araranguá, Brazil. (e-mail: roderval@yahoo.com.br).

J.B. Silva, is a researcher at Universidade Federal de Santa Catarina(UFSC), Informatics, Araranguá, Brazil. (e-mail: juarezbs@mail.com).

This article is an extended and modified version of a paper presented at the International Conference on Remote Engineering & Virtual Instrumentation (REV2012), held at University of Deusto, Bilbao, Spain, July 4-6, 2012. Received 8 August 2012. Published as resubmitted by the authors 18 December 2012.