FIELDBUS: DEVELOPING A LABORATORY PROTOTYPE FOR LEARNING PURPOSES

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Abstract *- This paper presents a distributed control and measurement system based on the Foundation Field Bus protocol. A system's prototype is described together with some implementation details and experimental results. The system also includes interfaces for conventional measurement and control devices that are connected through 4-20 mA current loops. The proposed prototype seems to be a very suitable solution for teaching purposes since it is an open solution that can be used to integrate devices from different manufacturers, as long as the prototype is provided with the appropriate interface.*

Keyword *- Fieldbus, digital instrumentation, distributed control systems, control engineering education.*

I. INTRODUCTION

The usual solution, still considered nowadays, for industrial control and instrumentation systems is based on distributed control systems (DCS). However, after the development of smart sensing and actuating (SSA) devices [1-2], new solutions based on instrumentation and control systems interconnected by industrial area networks (IAN) [3-4] became a promising alternative to implement new and to update present instrumentation and DCS. In which concerns systems' operation and maintenance, these networks, and associated devices, have a large number of advantages that are well-known and described in the literature [3]. One of the main advantages that is always referred is device interoperability of field bus devices. However, this is a very ambitious objective and there are multiple protocols to interconnect fieldbus devices from different manufacturers. This circumstance creates additional problems in which concerns instrumentation and control engineering education. There are some commercial solutions for teaching purposes but they are usually very expensive and don't provide an easy integration with conventional instrumentation and control devices that are available in present instrumentation and control laboratories. According to our experience, it is always very important, particularly in this area, to access real data and to simulate and test real system's performance using laboratory prototypes. According to this objective, this paper presents a Foundation Fieldbus (FF) prototype that was developed in our laboratory for teaching purposes.
Section 2 of the paper focus the main characteristics of the FF protocol, section 3 includes the hardware description of the FF prototype, section 4 presents some experimental results and the last section, section 5, summarizes paper's conclusions.

II. FOUNDATION FIELDBUS

Foundation Fieldbus [5-10] is a fully digital solution designed to interconnect industrial control and instrumentation devices, such as proportional, integral and derivative (PID) controllers, programmable logic controllers (PLC), and transducers and actuators. Basically, FF defines a standardized hardware and software for IAN implementation of instrumentation and control systems (ICS). The protocol proposes two hierarchy levels. The lower hierarchy level, known as H1, is used to connect field devices and runs at 31.25 kbit/s over a single wire pair that can be used simultaneously to power instrumentation without requirements of external power supplies. The second hierarchy level, known as H2 or high speed Ethernet (HSE), is used to interconnect different fieldbus networks (H1) and mainly supports supervision, management and other system's global tasks. In this paper, only the first hierarchy level (H1) is considered.

III. CONCLUSION

This paper presented a FF prototype that was implemented and tested under laboratorial conditions. Although laboratory conditions are far way from industrial harsh environments, it can be concluded that, as expected, there are multiple advantages in FF instrumentation and control systems when compared with conventional DCS solutions designed for similar purposes. The implemented prototype includes analog and digital instrumentation that was associated with adequate interfaces, FF to current and current to FF converters. Testing results confirmed the theoretical expectations and a good system's performance for a mixed analog and digital instrumentation and control platform was obtained.
The proposed prototype is a very suitable solution for teaching purposes of academic students that require laboratory expertise in recent industrial instrumentation field technologies.

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