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STUDY, DESIGN AND DEVELOPMENT OF A MODBUS MASTER THAT EVALUATES THE MODBUS COMMUNICATION BETWEEN EQUIPMENTS

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ABSTRACT

Data communication is essential in any mechatronic system or product. It allows for devices to communicate with one another, for a more efficient and self-regulating system. To effectively rely on the communication between devices, the communication must firsts be tested and evaluated for errors and correct data transmission. Sensors and sensor data addresses can easily be switched and when a device is communicating with another, it is imperative that the correct sensor data is transmitted when a slave device receives a signal to do so. If this condition is not verified, the master device could be receiving wrong signals and coincidently sending alerts or warning messages to the user. In more extreme cases the device can enter an emergency shutdown situation and fail to restart.

The objective of this work is to study, design and develop a software device that allows the user to simulate, evaluate and verify the Modbus communication between the Platform Management System (PMS) of a ship and the main equipment on board. The PMS is the onboard static master device that displays all the received data to the ship's captain for analysis. This work focuses in particular on a ship's generators, where the available signals will be assessed. The signals, stipulated in the equipment's specification documents, are transmitted directly from the equipment and are then received by the PMS. The PMS and the onboard equipment are programmed by various entities, of which, can all make mistakes while programming and therefor, the sensor and warning names and messages are not coherent with the corresponding values.

Keywords: modbus master, modbus slave, RTU, serial, Arduino slave, generator set.

INTRODUCTION

The idea of a master Modbus program was to be able to fix in advance the possible programming errors and / or assembly errors that otherwise could only be detected in the final stages of the ship's completion when testing the equipment altogether, and possibly leading to a delivery delay and therefor an increase cost in labor and fees. The program also allows for direct importation of a signal formatting text file which the program uses to format the signal data before displaying it to the user. Also, it allows for data logging, the user can monitor the signals over time in a graph and save them for a later analysis.

A plethora of background information needed to be used and understood for the completion of this project. The Modbus protocol (Modicon, 1996) was intensely studied in order to allow for correct understanding of how the protocol works as well as how to use it. The Arduino IDE software was used to program the Arduino microcontroller (Arduino, n.d.) to simulate the

generator set operation. The LabVIEW platform (Aprenda Sobre O LabVIEW: Introdução à Programação Gráfica No LabVIEW) was used to create the master program and produce the Modbus session using low level communication blocks. Excel® macros were also used to create a uniform text file with all the signal names and formatting information from the various manufacturer datasheets available. A generator set was also studied in order to create a generator set simulator that can be correctly modeled and programmed.

RESULTS AND CONCLUSIONS

The Arduino was programmed with some sample signals from the generator's datasheet and the Modbus RTU protocol was implemented using a Modbus library (Sarmento, 2015). Physical connections had to be made to the computer's serial connection and to other peripheral devises that would change the signal magnitude. The Arduino generator slave was tested and debugged using a simple Modbus master program (elbar, 2016) which would display the communication packets.

NAVAL MB Master is the name of the program created for this work. Initially, the program was planned to consists of basic functions for communication. The program was then created in the LabVIEW platform and more functions were added as individual modules or sub Vis that could also be useful to the program. These were individually tested and debugged before being implemented into the program. Modbus libraries were searched to facilitate the implementation of the Modbus protocol The program was exposed to rigorous testing using the generator set simulator to verify that all functions were operating as previously planned.

The program, when tested and presented to the shipyard was a success. All the functions and functionalities implemented into the program were working as expected. According to Alexandre, an electrical engineer, "The demonstration shown, seemed to display that the program had the potential to meet our expectations, but real field tests could not be completed due to the unavailability of the equipment."

It was a very gratifying and rewarding experience to be able to communicate with a "homemade" Modbus slave device over the Modbus protocol and have information flow in both directions. This idea could be expanded to control everyday appliances at home, a home security system, backyard sprinklers, etc. Numerous difficulties were encountered while completing the project, but were all overcome. Various work continuation ideas were also thought of that could later be employed in the program.

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