Embedded Measurement And Control: "Towards a generic data logger"

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***Abstract*—Several companies and research groups need to measure and control certain process parameters. However, the knowledge and expertise required to set up such a system is not trivial. During this project, research will be conducted how generic process measurement and control can be realized using embedded systems. This will lead to a generic solution whose operation and efficiency can be tested by a specific case.**

Keywords—
embedded;datalogger;generic;modular;measurement

I. Introduction

The goal of our project is to proof the concept of a generic data logger that will ease the use of implementing the same data logger in several different setups. The generic solution will make use of a uniform data structure in order to exchange data between the different entities of the system. Also, modular compatible interfaces will be developed in order to address the sensors and actuators which are connected to the embedded data acquisition system to be developed. This will be done in a simple and transparent manner. The generic solution will be verified in several different cases.

II. Requirements

A. Introduction

If you are using a data logger in your project, this is mostly a specific data logger only meant to do just one kind of measuring. If you want to measure another type of sensor or you want to add more sensors, you have to do a lot of adaptations or even buy a whole new system. We are narrowing down the research to data logger systems that are not specific, e.g. for process industry.

Two types of research are being done to find out problems with data loggers. The first is based on our own informal contacts, looking at products being offered on the Internet and papers. The second is based on a survey[14] that we send to companies that use data loggers.

B. Issues

Based on our informal contacts and existing literature, we listed some issues that are the reality of data loggers today:

- No upgrades or reconfiguration from a distance.
- Inadequate security measures.
- No or not much use of modular and compatible parts. (Software & hardware)
- No or not much modular and universal data communication.
- No data compression before sending.
- Insufficient data storage on the data logger itself.
- No IPv6 support.
- Lack of performance to do statistical pre-processing.
- High power consumption.
- Weight and dimensions.
- No 24/7 access to the data
- No bidirectional communication to the server.

This list is not exhaustive.

The results of our survey confirmed the list above and produced even more requirements:

- Correct data retention after power failure.
- Data must be sent to the customer's own server.
- Compatibility/interconnection with other data loggers.
- The software must be open source.
- Data being stored in a .csv format.
- 24/7 access to the data.
- Change parameters of your data logger from the server.
- Preferred Ethernet connection to the server.
- Configurable and programmable interface.
- All kind of sensors should be measurable.
- A large community to help with issues.

This list is not limitative. Based on those issues and demands, we now know the requirements for our data logger.

III. Setup

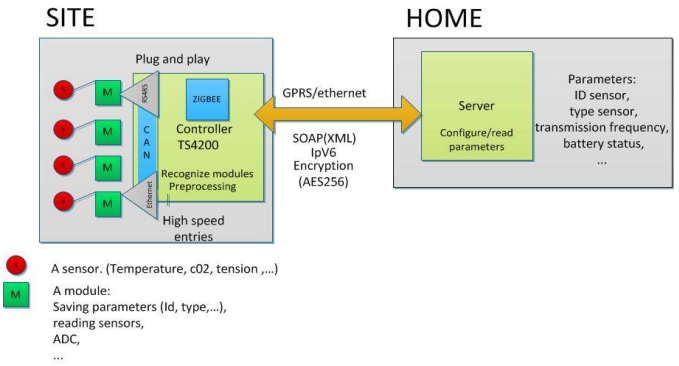
The whole concept based on the requirements that we've become, is to have a modular data logger. See figure 1 below. We have 3 parts:

The server at home that will host the data, where you can make graphs out of .csv files. Also you could set up parameters for the data logger, such as the logging frequency.

The second part is the **data logger** itself, this part will do the communication via GPRS/Ethernet to the server, which is a bidirectional communication. It must also make connections to the sensor modules and do some preprocessing of the data.

The sensor modules are the third part. This module must be cheap and must connect with the sensors and the datalogger interface. This means that you have one module to measure digital signals; another module that measures voltages from 0-10V, so you can easily expand your system.

Figure 1 Data logger setup.



A. *Server and communication to the server*

Via GPRS or Ethernet there will be communication to the server. This communication is based on the SOAP protocol. There will be AES256 encryption, to get the data secure to the server and back. You could also send parameters like transmission frequency to the data logger. Data can be saved to a .csv file. There is software available for setting the parameters and displaying graphs of your data.

B. *The data logger*

We have opted to use an existing embedded system [15] to make the data logger. This system has ample processing power to perform data encryption and statistical data preprocessing. This board is also able to communicate with the sensor module in several manners. Several Technologies were chosen to connect the sensors to the embedded system: an RS485 connection, a CAN bus connection, an Ethernet connection, and a wireless connection, probably via Zigbee. They were chosen based on speed, reliability, ease of use, … The data logger will also have a high-speed input.

C. *Sensor module*

The sensor module must communicate with the data logger via RS485, Ethernet, CAN or ZigBee. The modules are specifically made for each type of sensor. There will be a module to measure 0-10V sensors, there will be a module to measure digital sensors,… For developing this module we have chosen a 32-bit Infineon [16] microcontroller board. A simple 8-bit microcontroller would suffice, but the price and the options are better for a complete 32-bit microcontroller board . The sensor module will be able to have for example 10 entries for sensors of the same type (like digital). The sensor module also has to have A/D-conversion on board.

The idea is for every module to have an ID that is easily recognized by the data logger, so that the installation and configuration is a "plug and play" system.

D. *Conclusion*

The requirements are known for our proof of concept. There is a set-up to start with for building the data logger. So far, we have:

- Simple software where you can adjust some parameters and send them to the data logger, you can also receive the data and view it or download it in .csv format.
- At present, the communication to the server occurs only via Ethernet. We've used the SOAP protocol.
- The data logger is able to connect via RS232 to the sensor module.

Future work:

- Make sure that the module is going to be plug and play to the data logger (this will require working with ID's).
- Connect a sensor and see if the data is correctly displayed at the server.
- Get the bugs out of the server software and optimize.
- Do not only communicate via Ethernet to the server, but via GPRS as well.
- Communicate to the sensor modules via RS485,CAN, ZigBee, Ethernet.
- Data encryption.
- Statistical data preprocessing.
- Set parameters through the server.

The generic solution will be tested by a specific case.

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